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Report on Potential Exemptions from Vehicle Emissions Testing for Motorcycles, Collectible Vehicles and Vehicles 25 Model Years Old and Older

Prepared to meet the requirements of House Bill 2501 (2002) and House Bill 2294 (2003)

December 2004

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EXECUTIVE SUMMARY

House Bill 2501, as amended by HB 2294, requires the Arizona Department of Environmental Quality (ADEQ) to evaluate whether a request may be made to the U.S Environmental Protection Agency (EPA) to exempt vehicles 25 model years old or older in combination with motorcycles or collectible vehicles from being subject to the emissions testing requirement. This Report constitutes ADEQ's findings regarding these requests, and has been transmitted to the Governor, the President of the Senate, the Speaker of the House of Representatives, and the Maricopa and Pima Associations of Governments. The evaluation contained in this Report involves the air quality plans and emissions inspections programs in both the greater Phoenix and Tucson areas, which are named in A.R.S § 49-541 as Area A and Area B, respectively.

Beginning with the process of developing the methods and defining the data needed for conducting the analyses to be used in this report, ADEQ has engaged motor vehicle hobbyists and the motorcycling community. These constituencies were important contributors to the preparation of the Report. A public meeting was held to review the Draft Report on November 23, 2004, and this Final Report includes many of the changes suggested in comments received.

The methods used to gather data included conduct of surveys of collectible vehicle insurers and collectible vehicle and motorcycle owners, in addition to acquiring data from the State vehicle emissions inspections programs, other state agencies, air quality planning agencies and relevant air quality plans. The analyses conducted rely primarily on the EPA mobile source emissions model, MOBILE6.2, which relies on data from these other sources to generate potential emissions impacts of exempting classes of vehicles from emissions testing requirements.

The purpose of vehicle emissions testing programs, also called inspection and maintenance or IM programs, is to identify vehicles emitting excessive pollution and require repair of the malfunctioning systems causing those excess emissions. Consequently, the potential emissions increases that would occur as a result of exempting vehicles from emissions testing requirements are expressed as the "IM benefits from test and repair" of those vehicles. Table ES-1 provides a summary of these results.

HB 2294, Section 11, provides that ADEQ "shall make the exemptions request only if it determines that the continued emissions testing of motorcycles, collectible vehicles and vehicles that are twenty-five model years old or older or at least one combination of these categories of vehicles that includes a twenty-five model years old or older category does not provide a significant air quality benefit and is not necessary to satisfy the requirements of the state implementation or maintenance plans." Therefore, an exemption request is lawful only if both of the following conditions are met: including the category or combination of categories in the IM program does not provide a significant benefit *and* it is not required by the State Implementation Plan (SIP). This Report concludes that neither condition is met. The testing and repair of vehicles 25 model years old and older provides a significant air quality benefit: 11.77 metric tons

per day (mtpd) in Area A and 3.4 mtpd in Area B for CO. See Table ES-1. Further, EPA has approved the IM program in the SIP. Emissions from motorcycles, collectible vehicles and vehicles that are twenty five model years old and older were included in the baseline emissions modeling for the SIP. Accordingly, their continuance under the IM programs is necessary to satisfy the requirements of the SIP. As such, ADEQ is prohibited from requesting an exemption from emissions testing for these categories of vehicles.

HB 2294 also requires ADEQ to make recommendations for modifying the SIP with alternative control measures if exempting from IM programs motorcycles, collectible vehicles, and vehicles that are twenty-five model years old and older would not satisfy the requirements of the SIP. The federal Clean Air Act gives states the flexibility to substitute emission control programs for ones that will no longer be implemented providing the substitute controls have equivalent emissions reductions. Table ES-2 provides a list of pollution control measures that could be substituted for testing vehicles 25 model years old and older and motorcycles or collectible vehicles. More complete information on these control measures is contained in Section 3 of the Report.

Table ES-1
IM Benefits from Test and Repair of All Classes of Vehicles

Region	Vehicle Category	Each Class Individually (mtpd)		With =25 Model Year Old Vehicles (mtpd)		Percent of Area-Wide On-Road Emissions		Percent of Area-Wide Total Emissions Inventory	
		HC	CO	HC	CO	HC	CO	HC	CO
Area A	=25 Model Years Old (includes motorcycles)	0.82	11.77	-	-	1.14%	1.68%	0.25%	1.29%
	Collectible Vehicles[1]	0.03	0.32	0.82	11.81	1.14%	1.69%	0.25%	1.29%
	Motorcycles[1]	0.11	1.29	0.92	12.96	1.28%	1.85%	0.28%	1.42%
Area B	=25 Model Years Old (includes motorcycles)	0.36	5.64	-	-	1.17%	1.39%	0.42%	0.94%
	Collectible Vehicles[1]	0.01	0.14	0.36	5.66	1.18%	1.39%	0.42%	0.95%
	Motorcycles[1]	0.03	0.09	0.39	5.72	1.26%	1.41%	0.45%	0.96%

[1]Total with =25 model years old vehicles not additive as the =25 model years olds include part of this class.

Table ES-2
Potential Control Measures to Mitigate VEI Exemptions

Measure	HC reduction	CO reduction	Impact Year/Area
Implementation of the California Low Emission Vehicle Program (CA LEV)	4.3 mtpd (VOC)	95.0 mtpd	2005
Statewide	20.1 mtpd (VOC)	363.1 mtpd	2015
Mandatory No-Drive Days	19.1 mtpd	46.0 mtpd	1995/MAG region
CARB Diesel (On-Road and Off-Road)		9.2 mtpd	2004/MAG region
	7.1 mtpd		1999/ MAG region
	10.1 mtpd	11.3 mtpd	2010/ MAG region
Replace Vehicle Licence Tax With a Fuel Tax (Pay at Pump)	1.7 mtpd (VOC)	13.2 mtpd	2000
Expansion of the I/M Program Statewide	1.9 mtpd	10.8 mtpd	1995/MAG region
Portable Fuel Container Emission and Spillage Control (gas can rule)	11.5 mtpd	Not applicable	1998/Statewide
Eliminationof exemption for newer vehicles	0.75 mtpd	9.52 mtpd	2003/Area A
	0.27 mtpd	4.44 mtpd	2003/Area B
Parking Management	1.7 mtpd	7.6 mtpd	1995/MAG region
	1.5 mtpd	9.1 mtpd	2005/MAG region
Tax on Vehicle Miles of Travel	3.8 mtpd	5.4 mtpd	1995/MAG region
Vehicle Scrappage Programs	3.4 mtpd	4.2 mtpd	1995/MAG region
Ban Leaf Blowers	1.2 mtpd	3.5 mtpd	Area A
Extension and Expansion of Voluntary Lawn Mower and Lawn Equipment Replacement Program	0.4 mtpd	1.3 mtpd	1997-2000/ Maricopa County
Require I/M Testing for Non-Residents	0.2 mtpd	1.2 mtpd	1995/MAG region
Permanent Funding for Voluntary Vehicle Repair and Retrofit (VVRR)	0.05 mtpd	1.0 mtpd	2002/Area A
Programs	0.03 mtpd	0.5 mtpd	2002/Area B

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Prepared to meet the requirements of House Bill 2501 (2002) and House Bill 2294 (2003)

SECTION 1. INTRODUCTION

1.1 Requirements of the Legislation

HB 2501,[2] passed in 2002, required the Arizona Department of Environmental Quality (ADEQ) to request that the U.S Environmental Protection Agency (EPA) exempt motorcycles and collectible vehicles from being subject to the emissions testing requirement if ADEQ determines that the continued emissions testing of these vehicles does not provide a significant air quality benefit and it is not necessary to satisfy State Implementation Plan (SIP) requirements. HB 2294,[3] passed in 2003, modified the requirements of HB 2501 by requiring ADEQ evaluate exempting:

> "… motorcycles, collectible vehicles and vehicles that are twenty-five model years old or older or at least one combination of these categories of vehicles that includes a twenty-five model years old or older category from the state implementation or maintenance plans. The department shall make the exemptions request only if it determines that the continued emissions testing of motorcycles, collectible vehicles and vehicles that are twenty-five model years old or older or at least one combination of these categories of vehicles that includes a twenty-five model years old or older category does not provide a significant air quality benefit and is not necessary to satisfy the requirements of the state implementation or maintenance plans. The department of environmental quality shall submit a written report of its findings and activities regarding these requests to the governor, the president of the senate, the speaker of the house of representatives, and the Maricopa association of governments and the Pima association of governments on or before December 31, 2004."

The law provides further instructions to ADEQ: "The report shall include recommendations on how the state implementation or maintenance plans must be modified by considering alternative control measures in order to implement the vehicle emissions testing exemptions considered, if the department determines that the exemptions would not satisfy the requirements of the state implementation or maintenance plans."

An important distinction is the definition of "collectible vehicle." A vehicle is a collectible if it:

> "1. Bears a model year date of original manufacture that is fifteen years old or older.
>
> 2. Is of unique or rare design, of limited production and an object of curiosity.

[2] Arizona Laws, Forty-fifth Legislature, Second Regular Session, Chapter 146 (2002).

[3] Arizona Laws, Forty-sixth Legislature, First Regular Session, Chapter 258 (2003).

3. Is maintained primarily for use in car club activities, exhibitions, parades or other functions of public interest or for a private collection and is used only infrequently for other purposes.

4. Has a collectible vehicle or classic automobile insurance coverage that restricts the collectible vehicle mileage and requires the owner to have another vehicle for personal use."

The full text of both bills may be found in Appendix 1.

This report provides the background and the technical and legal analyses to meet these requirements.

1.2 Arizona's Vehicle Emissions Inspection Programs

The Arizona Legislature adopted centralized vehicle emissions testing programs in Maricopa and Pima counties in 1974, which were implemented in 1975. The program developed to its current form as engine, emissions control and testing technology improved, and to meet the challenge of continuing emissions reductions from vehicles in an effort to comply federal air quality standards. The Maricopa and Pima County programs were designed to address the specific air pollution problems in each of the two areas. Eastern Maricopa County, defined in law as Area A,[4] is classified as a "serious" nonattainment area for carbon monoxide, ozone and particulate matter. The Greater Tucson Area in Pima County, defined in law as Area B,[5] was designated nonattainment for carbon monoxide, but, in 2000, was redesignated to attainment. The Vehicle Emissions Inspections Programs have been credited with being among the most important control programs for improving air quality in both the Phoenix and Tucson metropolitan areas.[6]

The purpose of Vehicle Emissions Inspections Programs (VEIPs) is to identify the vehicles with excess emissions, provide basic information that assists with diagnosing malfunctions that cause the excess emissions, and require repair of the vehicle to bring emissions into compliance with standards. Inspection *and* maintenance or IM is a generic term for vehicle emissions inspection programs like Arizona's. As such, the Arizona VEIPs will primarily be referred to as the Arizona IM programs in the remainder of this report.

Tables 1.1 and 1.2 summarize the emissions tests performed in each of the areas.

[4]See ARS §49-541(1). Area A also includes a small portion of Yavapai County near Lake Pleasant, and part of northern Pinal County, including Apache Junction and Gold Canyon.

[5]See ARS §49-541(2).

[6]See Wenzel, T., "Using Program Test Result Data to Evaluate the Phoenix I/M Program" (December 1999)

Table 1.1
Summary of Area A Vehicle Emissions Tests

Test Name	Description	Vehicles Subject to Test	Test Frequency	Vehicles Tested in 2003 (% of total initial tests)
On-Board Diagnostics (OBD)	The on-board computer that controls the operation of the fuel, ignition, and emissions control systems is polled to determine if malfunctions that affect emissions have occurred.	Spark-ignited light duty cars and trucks, MY 1996 and newer	Biennial	273,799 (33.2%)
Arizona Transient Loaded (IM147)	The vehicle is run on a dynamo-meter under various loads to simu-late a driving cycle; mass emissions (grams/mile) are measured during the simulated driving cycle and compared to standards set based on model year and classification of the vehicle.	Spark ignited light duty cars and trucks, MY 1981 through 1995 plus 1996 and newer light duty alternative bi-fuelled vehicles	Biennial	394,186 (47.7%)
Loaded/Idle	The vehicle is run both at idle and under a constant load on a dynamo-meter; emission rates (parts per million or percent) are measured under both conditions and compared to standards set based on model year and classification of the vehicle.	Spark ignited light duty cars and trucks, MY 1967 through 1980; spark ignited heavy duty vehicles MY 1967 and newer; 1996 and newer heavy duty alternative bi-fuelled vehicles	Annual	101,145 (12.3%)
Idle only	See Loaded/Idle	Motorcycles, Non-OBD vehicles that cannot tested under loaded operation (e.g., constant 4-wheel drive) MY 1967 and newer	Annual	30,276* (3.7%)
Diesel Loaded	The opacity of the exhaust smoke is measured while the vehicle is operated under a constant load on a dynamometer	MY 1967 and newer diesel powered vehicles with GVWR of 8,500 lbs or less	Annual	3,289 (0.4%)
Diesel Snap-Acceleration (SAE 1667)	The opacity of exhaust smoke is measured under open-throttle conditions while the vehicle is out-of-gear and stationary	MY 1967 and newer diesel powered vehicles GVWR greater than 8,500 lbs	Annual	23,117 (2.8%)

*Motorcycles only: 22,053

Table 1.2
Summary of Area B Vehicle Emissions Tests

Test Name	Description	Vehicles Subject to Test	Test Frequency	Vehicles Tested in 2003 (% of total initial tests)
On-Board Diagnostics (OBD)	The on-board computer that controls the operation of the fuel, ignition, and emissions control systems is polled to determine if malfunctions that affect emissions have occurred.	Spark-ignited light duty cars and trucks, MY 1996 and newer	Biennial	102,202 (27.4%)
Loaded/Idle	The vehicle is run both at idle and under a constant load on a dynamo-meter; emission rates (parts per million or percent) are measured under both conditions and compared to standards set based on model year and classification of the vehicle.	Spark ignited vehicles (excl. motorcycles) MY 1981 through 1995 plus 1996 and new vehicles that cannot be tested with OBD	Annual	223,482 (59.8%)
Idle only	See Loaded/Idle	Spark ignited vehicles, MY 1967 through 1980 (incl. motorcycles), Non-OBD vehicles that cannot tested under loaded operation (e.g., constant 4-wheel drive) MY 1967 and newer	Annual	39,364* (10.5%)
Diesel Loaded	The opacity of the exhaust smoke is measured while the vehicle is operated under a constant load on a dynamometer	All diesel powered vehicles MY 1967 and newer	Annual	8,687 (2.3%)

*Motorcycles only: 6,240

1.3 Characteristics of the Vehicle Classes Being Considered for Exemption from Testing

The legislation calls for evaluation of three classes of vehicles: those more than 24 model years old, collectible vehicles and motorcycles. A number of issues need to be taken into consideration regarding the impact of exempting vehicles from testing:

- Emissions control technology is different for different types of vehicles. Late model year motorcycles and heavy-duty gasoline fueled vehicles have only minimal controls (PCV and possibly computer controlled fuel injection and ignition), while their cohort light duty vehicles will have the latest technology controls for their model years.

- Emissions technology improved over time because of new requirement set by federal and California State law. These standards had a significant impacts on emissions. Late model light duty vehicle emissions are 1% to 4% of those for pre-pollution control vehicles when they were new.

- On average, vehicles pollute more as they grow older. This is the result of normal wear-and-tear on the engine, fuel and emissions control systems. This is not to say that every vehicle will pollute less than its older cohorts. The actual condition of the vehicle is the result of a large number of variables, including the amount of regular maintenance the vehicle received during its lifetime, how the vehicle was driven (e.g., primarily in-town v. on-highway, the amount of aggressive acceleration or heavy use, such as towing), and the overall durability of the engine and emissions controls systems (may be a function of make and model, or a vehicle-specific durability issue).

Table 1.3 is an example of how all of these factors may relate to emissions:

Table 1.3
EPA MOBILE6.2* Model Estimated Average Emissions for Three Classes of Vehicles

	Light Duty Vehicles MY 1981-2003	Light Duty Vehicles MY 1967-1980	Motorcycles
Carbon Monoxide	10.1 g/mi	22.7 g/mi	13.4 g/mi
Hydrocarbons	1.06 g/mi	1.57 g/mi	1.94 g/mi

*Based on Maricopa County fleet characteristics and climate.

As a result, identification of emissions related problems and their repair through a vehicle emissions inspection program can have a significant air quality impact. A 50% decrease in emissions for a vehicle that emits 200 g/mi will have a much greater overall impact it would for one that emits 50 g/mi. How all these factors interrelate can be further illustrated using the statistics from the Arizona VEIP, as illustrated in Tables 1.4 and 1.5, and Figures 1.1 and 1.2.

Table 1.4
Maricopa County Tested Fleet Characteristics for Calendar Year 2003

	Number	Percent of Tested Fleet	Failure Rate	Percent of Failures
Total Tested Fleet	825,812	100%	18.6%	100%
Collectible Vehicles	3,800[7]	0.05%	N/A[8]	--
Motorcycles	22,053	2.7%	20.5%	3.0%
Vehicles >24 Model Years (1967-1979)	59,860	7.2%	39.8%	15.6%

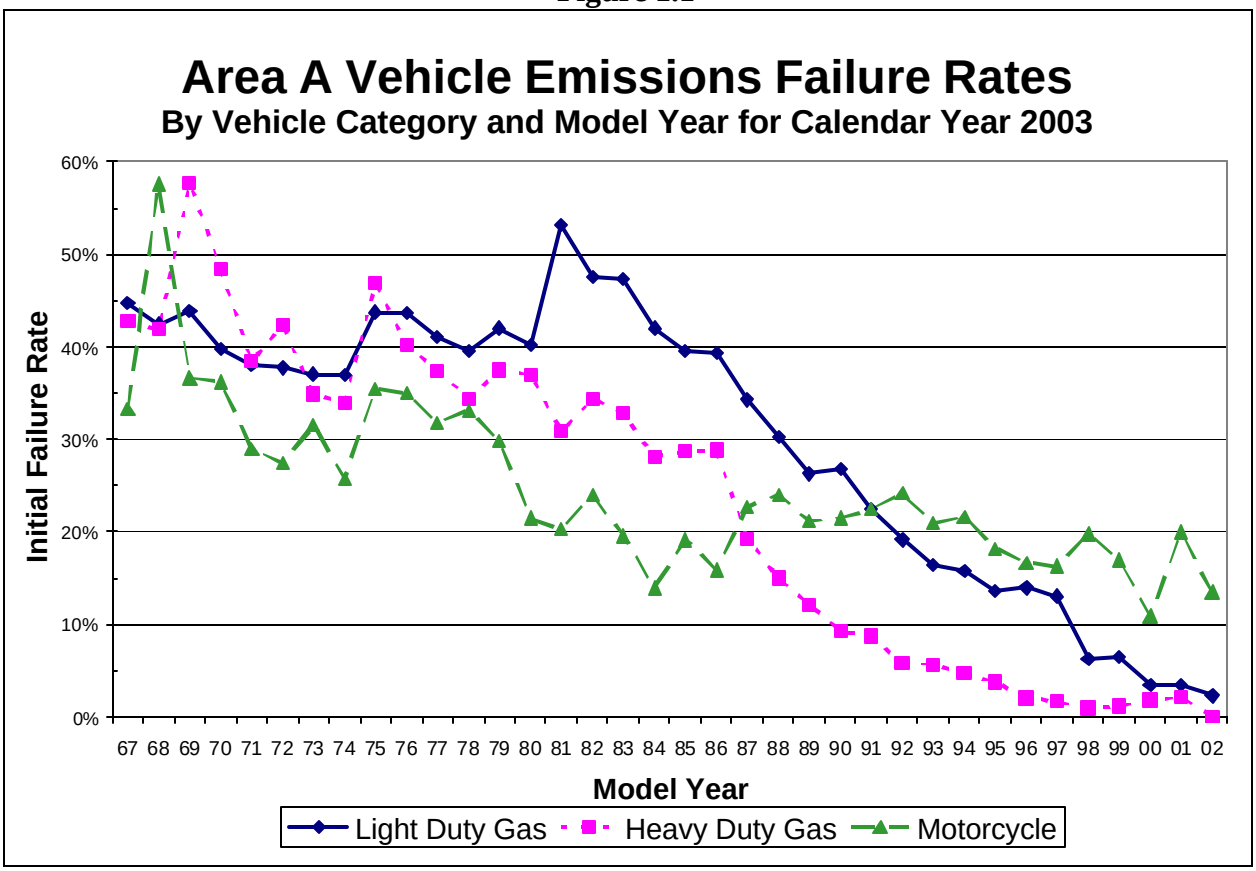
[7]Estimated based on the survey of collectible vehicle insurers and prorating total number of policies (7,100) by the percent vehicles of model years 1967 through 1989 from the collectible vehicle owners survey (73%), and the 2003 vehicle test population for light duty vehicles model years 1967 through 1989 in both counties (73%/27% split). The number of collectible vehicle policies estimated for the entire state was used to provide an upper-bound estimate.

[8]The failure rates for collectible vehicles are discussed in Section 2.

Table 1.5
Pima County Tested Fleet Characteristics for Calendar Year 2003

	Number	Percent of Tested Fleet	Failure Rate	Percent of Failures
Total Tested Fleet	373,734	100%	9.7%	100%
Collectible Vehicles	1,400[6]	0.4%	N/A[7]	--
Motorcycles	6,240	1.7%	5.1%	0.9%
Vehicles >24 Model Years (1967-1979)	28,179	7.5%	24.4%	19.1%

Figure 1.1

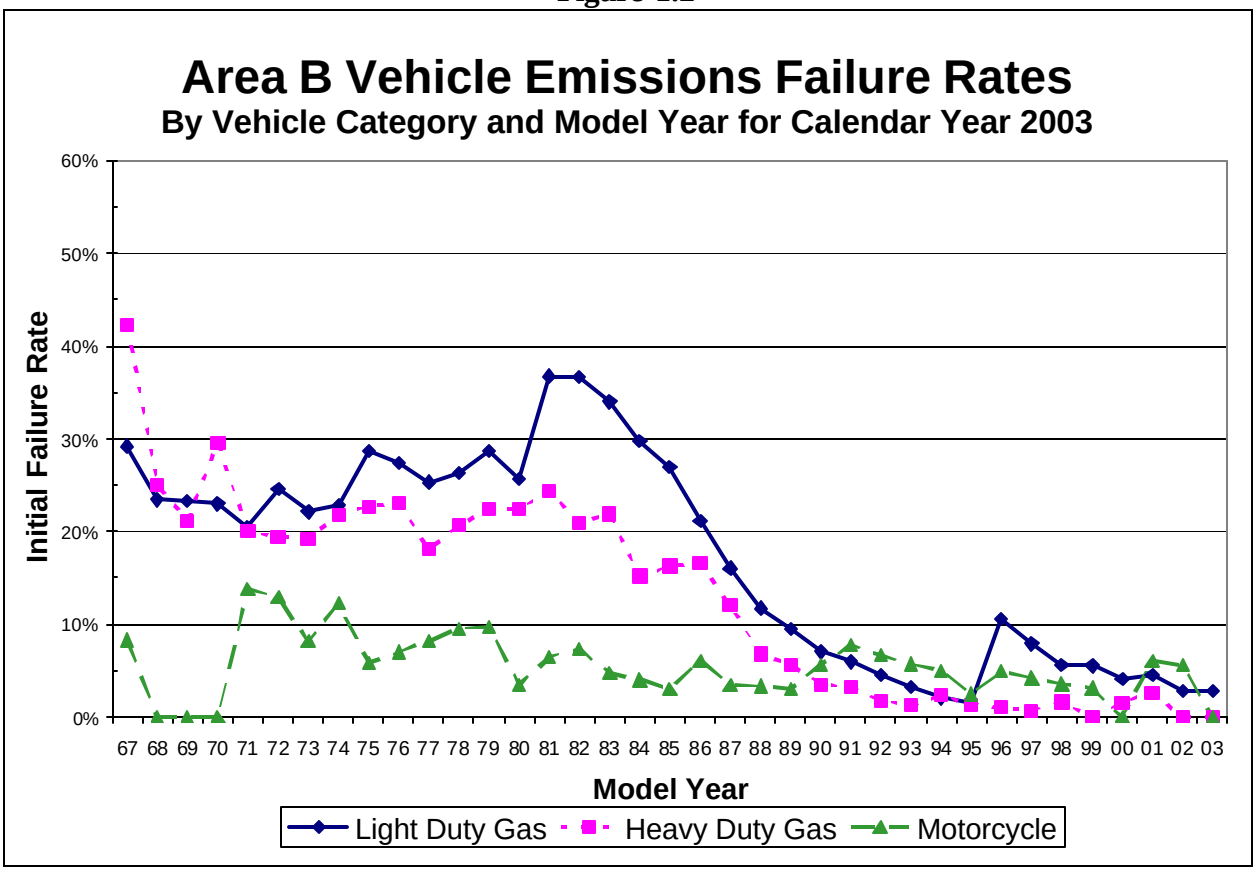


The conclusions drawn from these data are:

- For light and heavy duty vehicles, failure rates increase with vehicle age. Excepting motorcycles, emissions test failure rates tend to top-out from 16 to 20 model years old and remain high.

- The Pima County program, being less stringent than the Maricopa County program, also has lower failure rates.

Figure 1.2



1.4 Public Process

From the outset, ADEQ engaged those most affected and interested in HB 2501 and HB 2294: the auto hobbyist communities, motorcycle rights organizations and air quality planning agencies. ADEQ conducted several meetings to discuss the information needed and the analyses that should be conducted to meet the requirements of the legislation. The Draft Report was released for public review on November 9, 2004, and a public meeting was held on November 23, 2004, to review and begin taking comments on the Report. Three written comments were received by the deadline of November 30, 2004. These written comments and ADEQ's responses to those and oral comment received during the public meeting are included in Appendix 4.

1.5 An Overview of the Analysis

This analysis relies on two major evaluations: Emissions test statistics for the three classes of vehicles being evaluated; and output from EPA's vehicular emission factor model, MOBILE6.2.

An emission reduction from subjecting a fleet of vehicles to the Arizona IM programs is referred to in this document as the "IM Benefit." The IM benefit for vehicles in this fleet will be determined by running the MOBILE6.2 model for a scenario that includes an IM program for such vehicles and a scenario that does not. The difference between the two resulting emission factors is the IM benefit. The MOBILE6.2 emissions model, like all of its predecessors, was developed using large data sets developed from "Federal Test Procedures"[9] of all classes of vehicles under a wide range of differing conditions, including: types of fuels; climatic conditions; elevations; vehicle age, mileage and state of repair; and IM program stringency and characteristics, including absence of an IM program. Numerous other data sources are also incorporated the equations that generate emissions figures within the model, such as mileage surveys, remote sensing study results and evaluations of IM programs throughout the U. S.

Two of the pollutants measured by the emissions tests are carbon monoxide and hydrocarbons. Each of these pollutants significantly impact air quality during different seasons in a year – carbon monoxide in winter and hydrocarbons during summer. Carbon monoxide is formed due to incomplete combustion and also due to the reduced efficiency of emission control devices which normally occurs in cold temperatures. The pollution problem is aggravated during winter when stagnant air and intense temperature inversions cause the pollutants to be trapped at ground level. Hydrocarbons, on the other hand, are a precursor to the formation of ozone, which is formed at higher summer temperatures in the presence of sunlight. Therefore, the evaluation will be done for each pollutant specific to winter and summer seasons, respectively.

In addition, because the vehicle fleet characteristics and the stringency of the emissions testing programs differ between Areas A and B, separate analyses were conducted for each area.

1.5.1 Data Used To Conduct the Analyses

The EPA MOBILE6 provides a substantial amount of flexibility to account for localized circumstances, which improves the accuracy of emissions estimates generated by the model. The data used include:

- Local climatic conditions, including altitude, temperature ranges and humidity, for each season;
- Types of gasoline used, particularly for Reid vapor pressure and cleaner burning and oxygenated gasolines;
- Registration distribution information by vehicle type and model year;

[9] The Federal Test Procedure is a laboratory emissions test that measures evaporative and tailpipe mass emissions over a simulated driving cycle that includes measurement of evaporative emissions with the vehicle parked before and after operation, cold- and hot-starts, and freeway and stop-and-go driving.

- IM Program Stringency (based on type of test and failure rates) and compliance rate (percentage of vehicles complying with the program requirements) for the vehicle fleets in question; and
- Annual miles traveled per-vehicle, which will be referred to as mileage accumulation. These are set by default using national survey results, broken down by vehicle class and model year. These data show that mileage accumulation decreases with vehicle age. Data that better reflect mileage for a specific vehicle age and class, or locally derived information could be used to adjust model results.

The other data relied upon are emissions test statistics,[10] Arizona Department of Insurance information on the numbers of collectible vehicle policies issued in Arizona, and a survey of owners of collectible vehicles. Also, the Modified Motorcycle Association conducted a survey of motorcycle owners. Because we were unable to match the reported motorcycle license plates with those recorded in the VEIP data base, we were unable to use these data.

1.5.2 How the Analyses Were Done

The primary objective of the analysis is to calculate the emissions reduction benefit that is derived from requiring the classes of vehicles in question to be in compliance with the IM Program standards. The only basis that EPA will accept for calculating this benefit is through the MOBILE6 model results. The core of the analysis involves running MOBILE6 for two scenarios – one with the Area A or Area B (as appropriate) IM program in place and one without the IM program in place:

$$EF_{No\ IM} - EF_{IM} = \text{IM benefit}$$

Where $EF_{No\ IM}$ = Emission factor with no IM program in place and
EF_{IM} = Emission factor with IM program in place

For the 25 model year old and older vehicles, the results from the model can be used directly, more or less. It gets more complicated for the collectible vehicles, primarily as it relates to mileage accumulation.[11] For motorcycles, it became very complicated, as the MOBILE6 model does not calculate any emissions benefit for subjecting motorcycles to IM requirements. Since credit has been taken in the SIP for testing motorcycles, calculating the benefit is necessary.

The actual analyses required many more steps than described above. Details on how all of these data were used, the analyses conducted and specific steps taken to conduct the analyses, and the results are explained within the Technical Support Documents contained in Appendix 2.

[10] Measurements from the Arizona emission tests of individual vehicles were not used.

[11] It was hypothesized that the failure rate for collectible vehicles would be less than that for the overall cohort fleet. When the emissions testing records of the vehicles documented by their owners in the survey were evaluated, however, the raw failure rate was slightly greater than that of the cohort fleet. Since the error bounds on the failure rate for the surveyed vehicles is relatively large, the failure rate of the sample is not significantly different from the failure rate for all vehicles for the same model year cohort.

1.6 Clean Air Act Requirements for Relaxation of Approved Pollution Control Programs

1.6.1 Clean Air Act §110(l) and Applicable Case Law

The 1990 Clean Air Act Amendments, effective November 15, 1990, added Section 110(l) [42 United States Code Section 7410(l)]. It reads as follows:

> "(l) Plan Revisions—Each revision to an implementation plan submitted by a State under this Act shall be adopted by such State after reasonable notice and public hearing. The Administrator shall not approve a revision of a plan if the revision would interfere with any applicable requirement concerning attainment and reasonable further progress (as defined in section 171), or any other applicable requirement of this Act."

Because EPA "views each type of SIP revision as presenting unique issues that should be addressed on a case-by-case basis", EPA has not issued any "general guidance on section 110(l)."[12]

Apparently, neither the United States Supreme Court nor the United States Court of Appeals for the District of Columbia Circuit have considered EPA's standard of review of SIP revisions pursuant to Section 110(l). The United States Court of Appeals for the Ninth Circuit, which includes Arizona, determined in a 2001 case[13] that EPA's analysis must rationally connect its approval of a SIP revision to EPA's assessment of the air quality planning area's prospects for timely attainment and other Clean Air Act applicable requirements.

The Court noted that "applicable requirements concerning attainment and further progress" listed in Section 110(l) include the attainment deadlines established by the 1990 Clean Air Act Amendments at Section 110(a)(2)(C). The Court also looked at pre-1990 provisions for SIP approval in the Clean Air Act in Section 110(a)(3) and cited the U.S. Supreme Court statement in a 1975 case[14] that in reviewing SIP revisions, "[i]n each instance the [EPA] must measure the existing level of pollution, compare it with the national standards, and determine the effect on this comparison of specified emission modifications" and disapprove a SIP revision if "the plan as so revised would no longer insure (sic) timely attainment of the national standards." By implication, these cases also require that EPA's analysis must rationally connect SIP revision approval to Clean Air Act requirements for maintenance of the NAAQS in the air quality planning area. Because EPA had not performed the necessary analysis, the Ninth Circuit vacated EPA's SIP revision approval, and the matter was remanded to EPA for further consideration.

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[12] 61 Federal Register 16,051-052 (April 11, 1996).

[13] Hall v. EPA, 273 F.3d 1146 (9th Cir. 2001). EPA had approved the Clark County, Nevada new source review program rules in 1981 and had approved Clark County's revised rules in 1999 after determining that "If the SIP revision does not relax the existing SIP…then the SIP revision does not interfere with attainment [or] reasonable progress…requirements and no further inquiry is needed" because increased emissions would not be allowed.

[14] Train v. NRDC, 421 U.S. 60 (1975)

1.6.2 Application of Case Law to HB2501/HB2294 Analysis

The IM Program for Maricopa and Pima Counties were established in 1974 to achieve attainment of the NAAQS for CO and ozone. When the ozone standard was amended in 1979, however, the Greater Tucson Area became attainment for ozone.

Both counties consistently failed to meet the attainment deadlines set in the Clean Air Act of 1970 and under the 1977 amendments to the Act. The Greater Tucson Area, however, achieved attainment for the CO NAAQS beginning in the late 1980's and submitted a SIP demonstrating attainment in 1989. A maintenance plan for the Greater Tucson Area was submitted to EPA and was approved; it was finally designated attainment by EPA in 2000. Pursuant to the 1990 Clean Air Act Amendments, the applicable attainment deadlines for the CO and 1-hour ozone NAAQS were 2000 and 1999, respectively. Attainment was achieved for both pollutants, and EPA made findings that Maricopa County had attained the 1-hour ozone standard in 2001 and the CO standard in 2004. Maintenance plans for these pollutants in Maricopa County have been submitted to EPA for review and approval.

In 1997, EPA revised the ozone standard based on 8-hour average concentrations, for which exceedances have been widespread within Maricopa County. Effective June 15, 2004, the eastern portion of Maricopa County was designated nonattainment for the 8-hour ozone standard and the attainment deadline is 2007 (i.e., no violations of the NAAQS in 2005, 2006 and 2007).

To approve exemption of any vehicles from the Maricopa County SIP's IM requirement, EPA would have to measure the existing level of pollution, compare it with the national standards, and determine the effect on this comparison of specified exemptions and disapprove a SIP revision if the plan as so revised would no longer "insure (sic) attainment of the national standards by the 1990 Clean Air Act Amendments attainment deadlines," including attainment of the new 8-hour ozone standard by 2007 and maintenance of the CO NAAQS.

To approve exemption of any vehicles from the Pima County SIP's IM requirement, EPA would have to measure the existing level of pollution, compare it with the national standards, and determine the effect on this comparison of specified exemptions and disapprove a SIP revision if the plan as so revised would no longer ensure maintenance of the CO and Ozone NAAQS.

To the extent that any attainment or maintenance demonstrations have relied, or in the case of the 8-hour ozone standard will in the future rely, on all of the emissions reductions in the SIP, EPA could only approve such exemptions if substitute control measures that achieve equivalent emission reductions were added to the SIP.

SECTION 2. TECHNICAL ANALYSIS

2.1 Introduction

Arizona Administrative Code, Title 18, Chapter 2, Article 10 requires the Director of Arizona Department of Environmental Quality (ADEQ) to administer Vehicle Emissions Inspectons Programs in Areas A and B (as defined in ARS§ 49-541). Vehicles to be inspected by the Programs are specified in R18-2-1003. The emissions testing component of the Programs is designed to reduce pollution by requiring vehicles that exceed the emissions standards contained in R18-2-1031 to be repaired and brought into compliance with those standards. The reduction in emissions achieved by this requirement is the "IM benefit." If either vehicles 25 years old and older, collectible vehicles or motorcycles were exempted from IM requirements, the emissions reductions associated with the IM benefit would be foregone. Calculating the IM benefit for testing each of these classes of vehicles is the purpose of this technical analysis.

The general approach to determining the IM benefit is to estimate emissions with no IM program in place ($E_{No\ IM}$) and with an IM program in place (E_{IM}). The difference between the two, $E_{No\ IM}$-E_{IM}, is the IM benefit. This estimation was done using EPA's latest version of motor vehicle emission factor model, MOBILE6.2.

The analyses estimate the emissions reductions benefits of the Programs for hydrocarbons (HC),[15] a precursor for ozone pollution, and carbon monoxide (CO). HC is a significant pollutant for ozone formation, a pollution problem restricted to May through September, and high concentrations of CO are restricted to the late autumn and winter months. Consequently, the modeling to estimate HC emissions was performed for climatic conditions representing an average high ozone summer day, while climatic conditions for an average winter season day were applied to the model for calculating CO emissions. In addition, Area A and Area B have been modeled separately, considering their characteristics relative to demography, travel patterns, vehicle registrations, stringency of their Programs, weather patterns, and topography.

Following this general approach, analysis of each vehicle category (motorcycles, collectible vehicles and vehicles 25 model years old and older) was tailored to apply to the specific class of vehicles being analyzed.

[15]Although hydrocarbons and nitrogen oxides are both precursors to ozone, in Areas A and B, vehicles of model year 1980 and older are subject to the idle and loaded tests, which do not test for nitrogen oxides. Therefore, only hydrocarbons emissions will be modeled for the summer season.

2.2 Modeling

The following data, with their sources identified were used to tailor the emissions analyses conducted for each class of vehicle and area:

Input Parameters	Area A	Area B
For use in MOBILE6		
IM Program	Required under ARS 49-542	Required under ARS §49-542
Registration Distribution	ADOT MVD 2003 registration data and Vehicle Emissions Inspection (VEI) statistics	Same
Calendar Year	2003	2003
Evaluation Month	July for Summer January for Winter	Same
Altitude	Low altitude	Avg. of low and high altitudes
Min/Max temperatures from National Weather Service	Summer – 75.5 / 102.5 Winter – 49.2 / 72.6	Summer – 68.0 / 96.2 Winter – 46.6 / 72.6
Fuel RVP (psi)	7.0 for Summer; 9.0 for Winter Source: Caps from ARS §41-2083; MAG CO and ozone plans	8.0 for Summer; 10.8 base RVP with 1psi ethanol waiver for Winter Source: PAG
Oxygenated fuels	2.0% O_2 for Summer; 3.5% for Winter Per standards from ARS §§ 41-2123 and 2124	0% for Summer; 1.8% for Winter Source: PAG CO Limited Maintenance Plan
Mileage Accumulation Rate	National averages from MOBILE6.2[16]	Same
IM Program Stringency - Expected failure rate	2003 ADEQ VEI statistics	Same
IM Program Compliance Rate - % of fleet complying with program requirements	96% - MOBILE6 default	Same
For IM Benefits Calculations (except for Collectible Vehicles)		
Area-Wide Vehicle Miles Traveled (VMT) per day	68,000,000 miles/day Source: MAG	19,382,125 miles/day Source: PAG

Three errors were made in the analysis conducted for Draft Report regarding MOBILE6.2 inputs for Area B, which were corrected in this Final Report:

1. The low altitude factor was set;
2. Wintertime RVP was assumed to be at 9.0;

[16] MOBILE6.2 lumps all vehicles 25 years old and older into one age cohort. Mileage accumulation rates are described within the MOBILE6.2 model as mathematical functions of vehicle age for each of over 20 different classes of vehicles (e.g., light duty vehicles, two categories of light duty trucks, heavy duty vehicles by weight class), which can be extrapolated to model years in excess of 25 years old. See "Fleet Characterization Data for MOBILE6" (EPA, September 2001).

3. The oxygen content of gasoline was assumed to be 3.5%.

In addition, the area-wide VMT figure was too high, at 23,762,562. Correcting these errors influenced the results for Area B. Reducing VMT will reduce the amount of IM benefits because IM benefits are directly proportional to the amount of VMT. Making the altitude adjustment increased modeled HC emissions because the effective vapor pressure of gasoline increases with elevation; i.e., gasolines with the same RVP will evaporate more quickly at higher elevations than at lower elevations. Increasing wintertime RVP and reducing oxygen content both increase tailpipe emissions. As a result, the net impact of adjustments to altitude and gasoline properties inputs to MOBILE6.2 are an increase in the IM benefit. Specific explanation will be included below.

Detailed explanations and calculations for each analysis are included in Technical Support Documents (TSDs) contained in Appendix 2.

2.3 Analytical Methods

2.3.1 25 Model Years Old And Older Vehicles

Vehicles 25 years old and older were analyzed using data described in Section 2.2, above. IM benefits obtained from the model are expressed in grams/mile driven. VMT obtained from the national average mileage accumulation data has been extrapolated to 36 years and applied to each model year 1967-1979. These data were then mapped to match the registration distribution. The sum of all weighted VMT by age and vehicle class equals the total VMT for this category of vehicles. This procedure was performed for both Area A and Area B. Mass emission reductions are estimated in metric tons per day (mtpd).

VMT x IM benefit in grams/mile/1,000,000 grams/ton = Mass emissions in metric tons per day.

Sample calculation for CO in Area A:

$$\frac{514{,}727 \text{ miles} \times 22.669 \text{ grams/mile}}{1{,}000{,}000 \text{ grams/ton}} = 11.669 \text{ mtpd}$$

The IM benefit is then expressed as a percentage of the region-wide emissions for each pollutant in Areas A and B. This particular analysis addresses all of the vehicles subject to the Arizona IM program except for motorcycles. Since MOBILE6.2 does not calculate the benefits of subjecting motorcycles to IM requirements, the benefits for test and repair of motorcycles 25 model years old and older needs to be added to the results. That additional benefit and will be taken into account in the summary of the results, presented in Section 2.4, below. Table 2.1 presents the results of this analysis for all vehicles excepting motorcycles.

Table 2.1
IM Benefits from Test and Repair of 25 Year Old and Older Vehicles

		IM Benefit (g/mile)	VMT (miles/day)	Tonnage Reduction (mtpd)	Total On-Road Emissions (mtpd)	Reduction as Percent of On-Road Emissions
Area A	**HC**	1.573	514,727	0.810	71.9[17]	1.13%
	CO	22.669		11.669	699.7[18]	1.67%
Area B	**HC**	2.173	161,772	0.356	30.3[16]	1.17%
	CO	34.818		5.644	406.7[19]	1.39%

For this class of vehicles, using the correct altitude and gasoline characteristics inputs to MOBILE6.2 for Area B resulted in a larger gram per mile IM benefit, which had a bigger influence on the results than the lower VMT figure.

2.3.2 Collectible Vehicles

As discussed earlier, HB 2501 defines collectible vehicles as meeting the following criteria:

1. The vehicle model year of original manufacture is 15 years or older;
2. The vehicle is of unique or rare design, of limited production and an object of curiosity;
3. The vehicle is maintained primarily for use in car club activities, exhibitions, parades or other functions of public interest; and
4. The vehicle is covered by a "collectible vehicle" or "classic automobile" insurance policy that restricts vehicle mileage and requires the owner to have another vehicle for personal use.

Therefore, by definition, not all 15 year-old vehicles are collectible vehicles. For the purposes of modeling, the age criterion was used along with two other sources of data: a survey of insurance companies who issue collectible vehicle policies that include the restrictions listed above; and a survey of owners of collectible vehicles, coordinated through the Arizona Automobile Hobbyists Council, which included license plate number, make, model and vintage, whether the vehicle was used for commuting or not, and annual mileage accumulation estimates.

The absence of a category for collectible vehicles in Motor Vehicles Division (MVD) records required other means to isolate such vehicles from a fleet of vehicles 15 years old and older. This was accomplished by combining the fraction of 15 year old vehicles in the entire fleet

[17] Average Tuesday, August 2006 from "One-Hour Ozone Redesignation Request and Maintenance Plan for the Maricopa County Nonattainment Area" (MAG, March 2004)

[18] Average Friday, December 2006 , from "Carbon Monoxide Redesignation Request and Maintenance Plan for the Maricopa County Nonattainment Area" (MAG, May 2003)

[19] Tons per day modeled by ADEQ and reviewed by PAG.

(obtained from registration distribution data and VEI statistics) and results of the two collectible vehicle surveys. Average annual mileage accumulated for collectibles was estimated from the survey of collectible vehicle owners. These data were used to calculate a fraction that was applied as the Adjustment Factor to the IM benefit for test and repair of all 15 year old light duty vehicles (LDVs).

Total VMT x IM benefit (grams/mile) x Adjustment Factor / 1,000,000 grams per ton = Mass emissions in metric tons per day

The following data, obtained from the collectible car survey, were used in this analysis:

Estimated total number of collectible vehicles in Arizona from insurer survey = 7,100[20]

Average miles driven/year/vehicle from collectible vehicle owner survey results = 1,800

Sample calculation for HC in Area A:
(33,727 miles x 0.0169 grams/mile) x 0.0102/1,000,000 grams/ton = 0.0006mtpd

Also, note that 89.5% of the collectible vehicles from the survey subject to IM requirements were at least 25 model years old. Consequently, the benefit for test and repair of those vehicles should not be taken into account when the results of this analysis are added to the 25 model years old and older class of vehicles. Table 2.2 presents the results of this analysis for all IM eligible collectible vehicles and those15 to 24 model years old.

Table 2.2
IM Benefits from Test and Repair of Collectible Vehicles

Region	Pollutant	IM Benefit (g/mile)	VMT (miles/day)	Tonnage Reduction for All Collectibles (mtpd)	Reduction as Percent of On-Road Emissions	Tonnage Reduction for 15-24 MY old Collectibles
Area A	HC	1.748	16,816	0.034	0.047%	0.004
	CO	16.974		0.319	0.046%	0.034
Area B	HC	1.755	6,899	0.012	0.04%	0.001
	CO	20.155		0.139	0.034%	0.015

Because the collectible vehicle population is so similar to the 25 year old and older class of vehicles, applying the correct gasoline characteristics for Area B a similar impact, slightly increasing calculated emissions benefits.

[20] The total for the State was used as a conservative estimate, in the event that the exemption from testing provides an incentive for collectible vehicle owners to purchase collectible vehicle policies.

2.3.3 Motorcycles

MOBILE6 is not designed to calculate credits for subjecting motorcycles to an IM program. Motorcycles must be treated as a class of vehicles recognizable by the model. This class of vehicles must also closely resemble motorcycles in its characteristics. Class 3 Light Duty Vehicles (LDV) fulfills this requirement because they are comparable in engine size and some characteristics with motorcycles. Also, 1980 and older LDVs and motorcycles are both subject to the idle test in Area A. In Area B, all LDVs are subject to the idle test. Therefore, Class 3 LDV was used as a surrogate for motorcycles. A correction factor, calculated to adjust the MOBILE6.2 results to accurately depict motorcycle emissions, was applied to the IM benefit obtained from the model. The technical support document in Appendix 2c explains how the correction factor was derived.

VMT x (VMT_{mc}) x IM benefit (grams/mile) x Correction Factor/1,000,000 grams/ton = Mass emissions in metric tons per day

Where VMT_{mc} = Fraction of VMT applied to motorcycles

Sample calculation for CO in Area A:

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68,000,000 miles x 0.005 grams/mile x 5.5 x 0.69/1,000,000 grams/ton = 1.2906 mtpd

Also, note that 8% of the motorcycles tested in Area A and 12% in Area B subject to IM requirements were at least 25 model years old. Consequently, the benefit for test and repair those older motorcycles should not be taken into account when the results of this analysis are added to the 25 model years old and older class of vehicles. Table 2.3 presents these results for all IM eligible motorcycles and broken out for those 25 model years old and older and 24 model years old and newer.

Table 2.3
IM Benefits from Test and Repair of Motorcycles

Region	Pollutant	IM Benefit (g/mile)	Tonnage Reduction for All Motorcycles (mtpd)	Reduction as Percent of On-Road Emissions	Tonnage Reduction Benefit for 24 MY old and newer	Tonnage Reduction Benefit for 25 MY old and older
Area A	HC	0.32	0.109	0.15%	0.100	0.009
	CO	3.80	1.291	0.18%	1.185	0.105
Area B	HC	0.31	0.030	0.1%	0.026	0.004
	CO	0.96	0.093	0.02%	0.082	0.011

For motorcycles, using the correct gasoline characteristics for Area B had less influence on the CO results than the lower VMT figure, resulting in a smaller IM benefit.[21]

[21] The Draft report contained an error – the IM benefit in Area B was 5.15 g/mi, which was not correctly transcribed from the TSD in Table 2.3.

2.4 Summary of the Results

All results need to be expressed in terms of area-wide emissions changes. Table 2.4 provides the most current emissions inventory estimates available for Area A and Area B.

Table 2.4
Emissions Inventories

Source Category	Area A (metric tons per day)		Area B[22] (metric tons per day)	
	VOC[23]	CO[24]	VOC	CO
Point	17.4	21.9	1.8	7.2
Area	101.4	29.7	22.9	7.8
Non-road mobile	61.0	161.0	11.4	176.8
On-road mobile	71.9	699.7	30.3	406.7
Biogenics	77.2	-	18.4	-
Total	328.9	912.3	84.8	598.5

In addition, the HB2294 requires consideration of collectible vehicle and motorcycles in combination with vehicles 25 years old or older. Double-counting benefits, however, needs to be avoided.

The collectible vehicle owner survey results indicated that the vast majority of the collectible vehicles – 90% – were 25 years old or older. Further, the IM Program history for the vehicles in the 15 to 24 year old cohort (though the numbers are very small) indicates that the failure rate for that cohort is very low (See Table 1 in the Collectible Vehicle TSD). Consequently, all of the IM benefit for test and repair of 25 year old and older vehicles includes the benefit for testing collectible vehicles.

For motorcycles, however, it can be assumed that the vast majority of the benefit for their test and repair is outside of the 25 year old and older vehicle category. Only 8% of the motorcycles are within that cohort, and failure rates for motorcycles are much less a function of vehicle age than the failure rates for other vehicle classes (See Figures 1.1 and 1.2, above). Consequently, all of the IM benefit for test and repair of motorcycles is assumed to be separate from that for all vehicles 25 years old and older.

Table 2.5 summarizes the result for each class of vehicles separately and combined with the 25 year old and older class.

[22]Tons per day calculated from annual totals. (PAG, personal communication)

[23]Average Tuesday, August 2006 from "One-Hour Ozone Redesignation Request and Maintenance Plan for the Maricopa County Nonattainment Area" (MAG, March 2004)

[24]Average Friday, December 2006 , from "Carbon Monoxide Resesignation Request and Maintenance Plan for the Maricopa County Nonattainment Area" (MAG, May 2003)

Table 2.5
IM Benefits from Test and Repair of All Classes of Vehicles

Region	Vehicle Category	Each Class Individually (mtpd)		With =25 Model Year Old Vehicles (mtpd)		Percent of Area-Wide On-Road Emissions		Percent of Area-Wide Total Emissions Inventory	
		HC	CO	HC	CO	HC	CO	HC	CO
Area A	=25 Model Years Old (includes motorcycles)	0.82	11.77	-	-	1.14%	1.68%	0.25%	1.29%
	Collectible Vehicles[25]	0.03	0.32	0.82	11.81	1.14%	1.69%	0.25%	1.29%
	Motorcycles[26]	0.11	1.29	0.92	12.96	1.28%	1.85%	0.28%	1.42%
Area B	=25 Model Years Old (includes motorcycles)	0.36	5.64	-	-	1.17%	1.39%	0.42%	0.94%
	Collectible Vehicles[21]	0.01	0.14	0.36	5.66	1.18%	1.39%	0.42%	0.95%
	Motorcycles[22]	0.03	0.09	0.39	5.72	1.26%	1.41%	0.45%	0.96%

2.5 Discussion

This evaluation addresses only the potential impact of exempting these classes of vehicles in 2003. Conducting the evaluation for future years would be considerably more difficult, but it is possible to estimate the potential impact into the future based on these results and other factors.

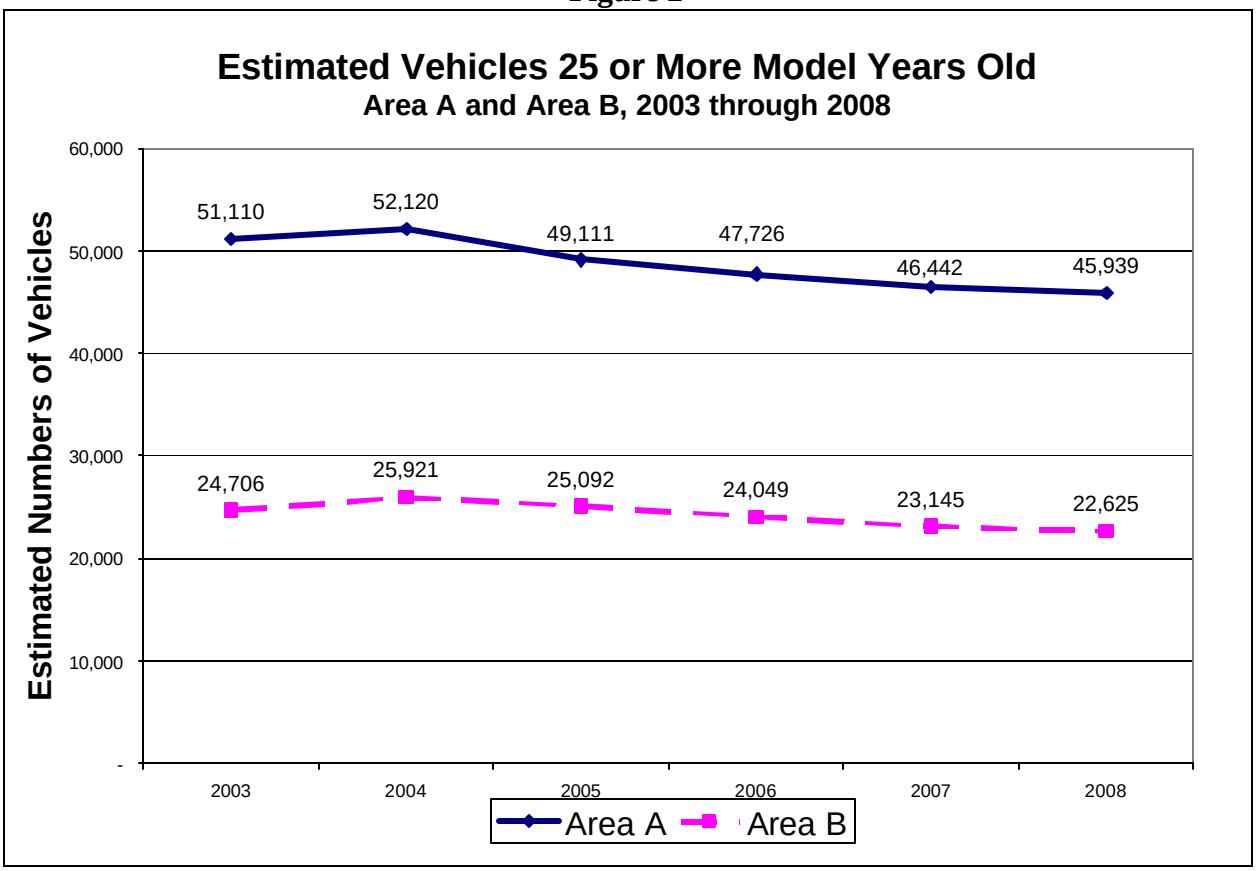
The vast majority of the expected emissions increases that would occur from exempting classes of vehicles from the Arizona IM requirements are associated with vehicles 25 model years and older.

Figure 2.1 provides a projection for the numbers of vehicles that would be exempted in the 25 model year and older category. These estimates were generated with survival curves for each model year using IM test volumes for 1994 through 2002. Because the testing requirements are anchored with the 1967 model year, the population could grow as additional model years are added to the exemption; i.e., for 2003, the exemption would apply to 1967 through 1979 vehicles, or 13 model years, while in 2008, 18 model years would be exempted.

[25] As 89.5% of all of the collectible vehicles in the survey subject to IM requirements were 25 model years old or older, those would be subsumed under the exemption for that class of vehicles. Consequently, only 10.5% of the IM benefit for test and repair of collectibles was added to that for the 25 model years and older class.

[26] Approximately 90% of the motorcycles tested were newer than 25 model years old (92% in Area A and 88% in Area B). Consequently, 90% of the IM benefit for test and repair of motorcycles was added to that for the 25 model years and older class.

Figure 2



These estimates suggest that the number of exempted vehicles will be declining over time. Taken by itself, this may be good news. Assuming the same attrition rate in the vehicle population, the number of exempted vehicles would not be reduced by 25% (thus reducing the emissions impact of the exemption by 25%) until 2011 to 2013.

Other intervening factors which would counteract the effect of the reduction in the number of exempted vehicles include:

- Starting in 2005, 1981 model year vehicles would become exempt. As the 1981 and newer vehicles are subject to more stringent testing requirements in both Areas A and B, the foregone air quality benefits achieved through these emissions reductions from exempted vehicles would become more significant on a per-vehicle basis with each additional model year exempted.

- This trend may be aggravated by the fact that failure rates increase with vehicle age. Figures 1.1 and 1.2 show that failure rate peaks for the 1981 model year at about 53% in Area A and 37% in Area B. Until those vehicles age further and more data become available in future years, it is not known whether that represents a peak failure rate for the 1981 and newer vehicles.

SECTION 3. CONCLUSIONS

Section 1 of HB 2501, as amended by HB 2294 provides that:

> "The [D]epartment shall make the exemptions request only if it determines that the continued emissions testing of motorcycles, collectible vehicles and vehicles that are twenty-five model years old or older or at least one combination of these categories of vehicles that includes a twenty-five model years old or older category does not provide a significant air quality benefit and is not necessary to satisfy the requirements of the state implementation or maintenance plans."

The potential emissions increases from exempting motorcycles in Area B and collectible vehicles in both areas A and B, from the Arizona IM programs, in and of themselves, may be considered insignificant because the impact would be less than a third of a metric ton per day (mtpd) of CO and only a few hundredths mtpd of HC (see Table 2.5). The basis for considering these emissions reductions insignificant is that SIP revisions submitted to and either approved or proposed for approval by EPA include control measures that reduce emissions as little as 0.1%,[27] which would be about 0.9 mtpd of CO or 0.3 mtpd of HC in Area A (see Table 2.4). As such, test and repair of those vehicles would not be necessary to satisfy the requirements of the SIP.

The same cannot be said for motorcycles in Area A and vehicles 25 model years and older in both areas. Test and repair of motorcycles in Area A provides a 1.29 mtpd benefit, which is significant. Further, test and repair of motorcycles was modeled as part of the baseline emissions control programs in CO and ozone SIPs for Maricopa County.[28] As such, it is necessary to satify the requirements of the SIP. The CO emissions benefits from test and repair of 25 model year old and older class is over 11.7 mtpd in Area A and 3.4 mtpd Area B, which is significant. Because the approved SIPs and maintenance plans includes these vehicles, continuing to require them to comply with the IM programs is necessary to satisfy the requirements of the SIPs and maintenance plans for both areas. As a result of this finding, ADEQ is prohibited by law from requesting from EPA approval for an exemption for any of these classes of vehicles in either area.

If, however, control measures were adopted that achieved equivalent emissions reductions as the exemptions from emissions testing, including these classes of vehicles in the IM programs would no longer be necessary to satisfy the requirements of the SIPs for areas A and B.

One other requirement of the HB 2294 is to enumerate potential substitute control measures. Table 3 is a compilation of emissions control programs that have been evaluated for inclusion in SIPs, but not adopted or implemented. The one exception is the measure "Portable Fuel Container Emission and Spillage Control", which has not been vetted in Arizona, but has been adopted and implemented in several jurisdictions in the U.S. It should be noted that this measure

[27] See "Revised 1999 Serious Area Carbon Monoxide Plan the the Maricopa County Nonattaiment Area," (MAG, March 2001).

[28] E.g., "MAG 1999 Serious Area Carbon Monoxide Plan for the Maricopa County Nonattainment Area", Appendices, Volume Two, page 4-20.

provides emissions reductions only for HC. For the most part, estimates of the tonnage reductions associated with these controls are from the reports in which these controls were evaluated, and, thus, may not be precise for either current or future conditions. In nearly every case, however, the expected emissions reductions will not change substantially. Developing contemporary assessments of the effectiveness of these emissions control programs is outside of the scope of this report.

One potential control measure was added in response to a comment on the Draft Report: Elimination of the emissions inspection exemption for newer vehicles. If this control measure were to be implemented, all new vehicles would need to be tested beginning with their first re-registration. It should be noted that the emissions benefit from removing this exemption is primarily a result of the large size of the population of vehicles that would be subject to testing and repair. The following table provides some calendar year 2003 statistics comparing the impact of eliminating the exemption for the newest vehicles in exchange for exempting the oldest vehicles:

	Vehicles 1-5 Model Years Old			**Vehicles = 25 Model Years Old**[29]		
	Number[30]	Failure Rate[31]	Number of Failures[32]	Number	Failure Rate	Number of Failures
Area A	772,337	4.34%	16,760	59,860	39.8%	23,849
Area B	170,652	4.36%	3,720	28,179	24.4%	6,877

[29] From ADEQ emissions test statistics for 2003; includes all vehicles.
[30] MVD registration statistics; includes only light duty vehicles.
[31] Based on the population of vehicles tested in 2003.
[32] These vehicles would be tested biennially ranther than annually, as is the case for vehicles older than the 1981 model year. As a result, the number of failing vehicles would come from approximately half of the total population.

Table 3: Potential Control Measures to Mitigate VEI Exemptions				
Measure	**HC reduction**	**CO reduction**	**Impact Year/Area**	**Source**
Implementation of the California Low Emission Vehicle Program (CA LEV) Statewide	4.3 mtpd (VOC) (5.1-5.3%) 20.1 mtpd (VOC) (30%)	95.0 mtpd (9.1%) 363.1 mtpd (38%)	2005 2015	Report of the Governor's Air Quality Strategies Task Force, 2/17/98
Mandatory No-Drive Days	19.1 mtpd (5.0%)	46.0 mtpd (11.1%)	1995/MAG region	Report to the Joint Legislative Oversight Committee on Air Quality Control Measures (HB 2129, Chapter 244, Laws 1993), 9/1/93
Adopt Reformulated Fuel Standards: CARB Diesel (D7) (On-Road and Off-Road)	<u>Summer (VOC)</u> 7.1 mtpd 10.1 mtpd	<u>Winter</u> 9.2 mtpd 11.3 mtpd	2004/MAG region 2010/ MAG region 1999/ MAG region 2010/ MAG region	Report of the Governor's Air Quality Strategies Task Force, 2/17/98
Replace Vehicle Licence Tax With a Fuel Tax (Pay at Pump)	1.7 mtpd (VOC)	13.2 mtpd	2000	Final Report to the Governor's Air Quality Strategies Task Force, Carbon Monoxide Subcommittee, 1/20/98
Expansion of the Vehicle Inspection/Maintenance (I/M) Program Statewide	1.9 mtpd (1.0%)	10.8 mtpd (2.6%)	1995/MAG region	Report to the Joint Legislative Oversight Committee on Air Quality Control Measures (HB 2129, Chapter 244, Laws 1993), 9/1/93
Elimination of the exemption of newer vehicles from IM	0.75 mtpd (0.2%) 0.29 mtpd (0.3%)	9.52 mtpd (1.0%) 4.44 mtpd (0.9%)	2003 Area A 2003 Area B	New
Portable Fuel Container Emission and Spillage Control (gas can rule)	11.5 mtpd	Not applicable	1998/Statewide	Inventory of U.S. Emissions from Portable Gasoline Containers, Final Report, University of California, Riverside, 7/31/01
Parking Management	1.7 mtpd (0.22%) 1.5 mtpd (0.22%)	7.6 mtpd (0.57%) 9.1 mtpd (0.24%)	1995/MAG region 2005/MAG region	Sierra Research Feasibility and Cost-Effectiveness Study (Mobile Sources), 6/93

Table 3: Potential Control Measures to Mitigate VEI Exemptions				
Measure	**HC reduction**	**CO reduction**	**Impact Year/Area**	**Source**
Tax on Vehicle Miles of Travel	3.8 mtpd (1.0%)	5.4 mtpd (1.3%)	1995/MAG region	Report to the Joint Legislative Oversight Committee on Air Quality Control Measures (HB 2129, Chapter 244, Laws 1993), 9/1/93
Vehicle Scrappage Programs	3.4 mtpd (0.9%)	4.2 mtpd (1.0%)	1995/MAG region	Report to the Joint Legislative Oversight Committee on Air Quality Control Measures (HB 2129, Chapter 244, Laws 1993), 9/1/93
Ban Leaf Blowers	1.2 mtpd	3.5 mtpd	Area A	Final Report of the Governor's Brown Cloud Summit, 1/16/01
Extension and Expansion of Voluntary Lawn Mower and Lawn Equipment Replacement Program	0.4 mtpd	1.3 mtpd	1997-2000/ Maricopa County	Off-Road Mobile Controls Subcommittee Revised Final Report, Governor's Brown Cloud Summit, 12/11/00
Require I/M Testing for Non-Residents	0.2 mtpd (0.1%)	1.2 mtpd (0.3%)	1995/MAG region	Report to the Joint Legislative Oversight Committee on Air Quality Control Measures (HB 2129, Chapter 244, Laws 1993), 9/1/93
Permanent Funding for Voluntary Vehicle Repair and Retrofit (VVRR) Programs[33]	0.05 mtpd 0.03 mtpd	1.0 mtpd 0.5 mtpd	2002/Area A 2002/Area B	FY 2004 Annual Rept., Maricopa Co. VVRR Program
Additional Emission Reductions From Consumer Products	0.9 mtpd (VOC) (5%)	Not applicable	Maricopa County	Report of the Governor's Air Quality Strategies Task Force, 2/17/98
Encourage Private Industry to Provide Effective Programs and Incentives to Enhance Trip Reduction	0.1 mtpd[34]	0.8 mtpd	Not specified	Report of the Governor's Air Quality Strategies Task Force, 2/17/98
Bicycle Facilities and Policies	0.1 mtpd[35]	0.5 mtpd	Not specified	Report of the Governor's Air Quality Strategies Task Force, 2/17/98

[33]Results for 746 1981-1992 MY vehicles that participated in the Maricopa County VVRR program. Before and after full IM147 tests and MOBILE6 mileage assumptions: 9.6 mtpy HC; 192.8 mtpy CO. Assumes funding sufficient to repair and retrofit 1,500 vehicles/year in area A and 800 vehicles/yr in Area B.

[34]Reported as 734 tpy of all pollutants. Estimated 6.3% of the total is HC and 44.2% is CO.

[35]Estimated 1.45 tpd for all pollutants. Estimated 6.3% of the total is HC and 44.2% is CO.

Table 3: Potential Control Measures to Mitigate VEI Exemptions				
Measure	**HC reduction**	**CO reduction**	**Impact Year/Area**	**Source**
Encourage Reduction of High School Student Vehicle Use	0.1 mtpd (VOC)	> 0.1 mtpd	Not specified	Report of the Governor's Air Quality Strategies Task Force, 12/2/96
High Occupancy Vehicle (HOV) Lane Pricing		0.01 mtpd	2000	Revised MAG 1999 Serious Area Carbon Monoxide Plan, March 2001
Minimize Use of Gas-Powered Lawn and Maintenance Equipment by Government Agencies		0.001 mtpd (< 0.1%)	2000	Revised MAG 1999 Serious Area Carbon Monoxide Plan, March 2001
Implement I/M 240 (147) Testing for Constant 4-Wheel-Drive Vehicles	(54% average for each failing vehicle)	(56% average for each failing vehicle)	1993-1994/Area A	Report of the Governor's Air Quality Strategies Task Force, 2/17/98
Commuter Rail Demonstration Project	Not available	Not available		Final Report to the Governor's Air Quality Strategies Task Force, Carbon Monoxide Subcommittee, 1/20/98
VLT Exemption or Discount for Vanpools or Shuttles	Not available	Not available		Final Report to the Governor's Air Quality Strategies Task Force, Carbon Monoxide Subcommittee, 1/20/98
Travel Reduction Program-Related Parking Cash-Out Program	Not available	Not available		Final Report to the Governor's Air Quality Strategies Task Force, Carbon Monoxide Subcommittee, 1/20/98
Ban Used Oil for Burning	Not available	Not available		Stationary and Area Source Subcommittee Revised Final Report, Governor's Brown Cloud Summit, 12/8/00
Provide Tax Incentives for the Purchase and Installation of Oxidation Catalysts on Heavy Duty Diesel Engines	Not available	Not available		On-Road Mobile Controls Subcommittee Revised Final Report, Governor's Brown Cloud Summit, 12/8/00
More stringent VOC bulk storage standards	Not available	Not applicable		Report of the Governor's Air Quality Strategies Task Force, 2/17/98

ADEQ
Arizona Department of Environmental Quality

Janet Napolitano, Governor
Stephen A. Owens, ADEQ Director

APPENDICES

Report on Potential Exemptions from Vehicle Emissions Testing for Motorcycles, Collectible Vehicles and Vehicles 25 Model Years Old and Older

December 2004

Appendix 1

House Bills

House Engrossed

State of Arizona
House of Representatives
Forty-fifth Legislature
Second Regular Session
2002

CHAPTER 146

HOUSE BILL 2501

AN ACT

URGING AN EXEMPTION FROM THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY FOR EMISSIONS TESTING FOR MOTORCYCLES AND COLLECTIBLE VEHICLES.

(TEXT OF BILL BEGINS ON NEXT PAGE)

Be it enacted by the Legislature of the State of Arizona:

Section 1. Request for state implementation plan exemption; report

The department of environmental quality shall contact the United States environmental protection agency and request a vehicle emissions testing exemption for either motorcycles, collectible vehicles or both from the state implementation or maintenance plan. The department shall make the exemption request only if it determines that the continued emissions testing of either motorcycles, collectible vehicles or both does not provide a significant air quality benefit and is not necessary to satisfy the requirements of the state implementation or maintenance plans. The department of environmental quality shall submit a written report of its findings and activities regarding this request to the governor, the president of the senate, the speaker of the house of representatives and the Maricopa association of governments on or before December 31, 2004. For purposes of this section, "collectible vehicle" means a vehicle that satisfies all of the following:

1. Bears model year date of original manufacture that is fifteen years old or older.

2. Is of unique or rare design, of limited production and an object of curiosity.

3. Is maintained primarily for use in car club activities, exhibitions, parades or other functions of public interest or for a private collection and is used only infrequently for other purposes.

4. Has a collectible vehicle or classic automobile insurance coverage that restricts the collectible vehicle mileage and requires the owner to have another vehicle for personal use.

5. At the time a vehicle is registered as a collectible vehicle, the department shall enter into the vehicle record the fact that the vehicle is covered by collectible vehicle or classic automobile insurance. If an insurer notifies the department of the cancellation or nonrenewal of the insurance coverage, the department shall cancel the registration of the vehicle and the vehicle's exemption from emissions inspection pursuant to section 49-542, Arizona Revised Statutes, unless evidence of coverage is

presented to the department within sixty days.

Sec. 2. Repeal

Section 1 of this act is repealed from and after December 31, 2004.

APPROVED BY THE GOVERNOR MAY 06, 2002.

FILED IN THE OFFICE OF THE SECRETARY OF STATE MAY 07, 2002.

Conference Engrossed
State of Arizona
House of Representatives
Forty-sixth Legislature
First Regular Session
2003

CHAPTER 258

HOUSE BILL 2294

AN ACT

AMENDING SECTIONS 28-450, 28-1098, 28-2051, 28-2091, 28-2134, 28-2154, 28-2356 AND 28-2401, ARIZONA REVISED STATUTES; AMENDING TITLE 28, CHAPTER 7, ARTICLE 15, ARIZONA REVISED STATUTES, BY ADDING SECTION 28-2515; AMENDING SECTION 28-4073, ARIZONA REVISED STATUTES; AMENDING LAWS 2002, CHAPTER 146, SECTION 1; RELATING TO VEHICLES; PROVIDING FOR CONDITIONAL ENACTMENT.

(TEXT OF BILL BEGINS ON NEXT PAGE)

Be it enacted by the Legislature of the State of Arizona:

Section 1. Section 28-450, Arizzona Revised Statutes, is amended to read:

28-450. Release of information prohibited; classification; definition

A. Notwithstanding section 28-447, the department shall not:

1. Divulge information from a vehicle title or registration record unless the person who requests the information provides to the department all of the following:

(a) The name of the owner.

(b) The vehicle identification number of the vehicle.

(c) The vehicle license plate number assigned to the vehicle.

2. Release a copy of a record or divulge information concerning a person's driving record unless the person requesting the driving record provides to the department all of the following:

(a) The name of the licensee or the name of the person whose record is requested.

C. Notwithstanding section 28-4088, a person whose license, registration or nonresident operating privilege is reinstated shall maintain proof of financial responsibility for two years after the judgment is satisfied.

Sec. 11. Laws 2002, chapter 146, section 1, is amended to read:

Section 1. Request for state implementation or maintenance plan exemption; report; definition

A. The department of environmental quality shall contact the United States environmental protection agency and request ~~a~~ vehicle emissions testing ~~exemption~~ EXEMPTIONS for ~~either~~ motorcycles, collectible vehicles AND VEHICLES THAT ARE TWENTY-FIVE MODEL YEARS OLD OR OLDER or ~~both~~ AT LEAST ONE COMBINATION OF THESE CATEGORIES OF VEHICLES THAT INCLUDES A TWENTY-FIVE MODEL YEARS OLD OR OLDER CATEGORY from the state implementation or maintenance ~~plan~~ PLANS. The department shall make the ~~exemption~~ EXEMPTIONS request only if it determines that the continued emissions testing of ~~either~~ motorcycles, collectible vehicles AND VEHICLES THAT ARE TWENTY-FIVE MODEL YEARS OLD OR OLDER or ~~both~~ AT LEAST ONE COMBINATION OF THESE CATEGORIES OF VEHICLES THAT INCLUDES A TWENTY-FIVE MODEL YEARS OLD OR OLDER CATEGORY does not provide a significant air quality benefit and is not necessary to satisfy the requirements of the state implementation or maintenance plans. The department of environmental quality shall submit a written report of its findings and activities regarding ~~this request~~ THESE REQUESTS to the governor, the president of the senate, the speaker of the house of representatives, ~~and~~ the Maricopa association of governments AND THE PIMA ASSOCIATION OF GOVERNMENTS on or before December 31, 2004. THE MARICOPA ASSOCIATION OF GOVERNMENTS AND THE PIMA ASSOCIATION OF GOVERNMENTS SHALL COOPERATE WITH, PROVIDE TECHNICAL AND EXPERT ASSISTANCE AND SUPPLY DATA AND OTHER NECESSARY INFORMATION TO THE DEPARTMENT FOR THE VEHICLE EMISSIONS TESTING EXEMPTIONS CONSIDERED. THE DEPARTMENT MAY ALSO REQUEST TECHNICAL ASSISTANCE FROM THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY. THE REPORT SHALL INCLUDE RECOMMENDATIONS ON HOW THE STATE IMPLEMENTATION OR MAINTENANCE PLANS MUST BE MODIFIED BY CONSIDERING ALTERNATIVE CONTROL MEASURES IN ORDER TO IMPLEMENT THE VEHICLE EMISSIONS TESTING EXEMPTIONS CONSIDERED, IF THE DEPARTMENT DETERMINES THAT THE EXEMPTIONS WOULD NOT SATISFY THE REQUIREMENTS OF THE STATE IMPLEMENTATION OR MAINTENANCE PLANS.

B. For THE purposes of this section, "collectible vehicle" means a vehicle that satisfies all of the following:

1. Bears A model year date of original manufacture that is fifteen years old or older.

2. Is of unique or rare design, of limited production and an object of curiosity.

3. Is maintained primarily for use in car club activities, exhibitions, parades or other functions of public interest or for a private collection and is used only infrequently for other purposes.

4. Has a collectible vehicle or classic automobile insurance coverage that restricts the collectible vehicle mileage and requires the owner to have another vehicle for personal use.

5. At the time a vehicle is registered as a collectible vehicle, the department OF TRANSPORTATION shall enter into the vehicle record the fact that the vehicle is covered by collectible vehicle or classic automobile insurance. If an insurer notifies the department OF TRANSPORTATION of the cancellation or nonrenewal of the insurance coverage, the department OF TRANSPORTATION shall cancel the registration of the vehicle and the vehicle's exemption from emissions inspection pursuant to section 49-542, Arizona Revised Statutes, unless evidence of coverage is presented to the department OF TRANSPORTATION within sixty days.

Sec. 12. Conditional enactment

A. Section 28-2356, Arizona Revised Statutes, as amended by this act is effective from and after June 30, 2004, only if the legislature appropriates $122,000 to the department of transportation to cover implementation costs.

B. The department of transportation shall notify in writing the director of the Arizona legislative council if the condition is met or not met.

APPROVED BY THE GOVERNOR MAY 27, 2003.

FILED IN THE OFFICE OF THE SECRETARY OF STATE MAY 27, 2003.

Appendix 2

Technical Support Documents

Appendix 2a

Technical Support Document

Evaluating Emissions Impacts of Exempting Light Duty Vehicles 25 Model Years Old and Older from Vehicle Emissions Inspections

Technical Support Document for Evaluating Emissions Impacts of Exempting Light Duty Vehicles 25 Model Years Old and Older from Vehicle Emissions Inspections

Introduction

The modeling was performed using EPA's vehicular emission factor model, MOBILE6.2. This analysis was modeled for two seasons – winter and summer, considering the significance of the two pollutants - carbon monoxide and hydrocarbons [1] which are typically wintertime and summertime pollutants respectively. This dual modeling procedure was repeated in each of the different situations as described further. Also, because Maricopa County and Pima County have different travel patterns and vehicle distributions, each county was analyzed separately.

The basic concept applied in the other analyses under HB 2501 was applied in this analysis as well. The IM benefit of subjecting vehicles in this fleet to the emissions testing program was determined by executing the model for a scenario that included an IM program for such vehicles and one that did not. The difference between the two was the IM benefit.

$EF_{No\ IM}$ - EF_{IM} = IM benefit
Where:
$EF_{No\ IM}$ = Emission factor with no IM program in place;
EF_{IM} = Emission factor with IM program in place;
IM benefit = Reduction in emissions from subjecting the 25 year old and older fleet to the IM program.

Because the model does not credit test and repair of motorcycles in an IM program, the IM benefit for 25 year old and older motorcycles was added from the motorcycles analysis to that estimated for 25 year old and older vehicles. In order to estimate emissions from motorcycles 25 years old and older, the fraction of motorcycles this age (25+ years), as determined from the VEI test data, was used.

Modeling methodology

MOBILE6.2 is capable of generating an output containing emission factors for the desired pollutant (in grams per mile) for a specific vehicle age. In this case, it is required to estimate emissions from 25 year old and older vehicles. In its computation, MOBILE6.2 lumps together all vehicles older than 25 years with vehicles that are 25 years old.

MOBILE6.2 requires the following inputs in order to estimate the required emissions:

[1] Although hydrocarbons and nitrogen oxides are both precursors to ozone, in Areas A and B, vehicles of model year 1980 and older are subject to the idle test, which does not test for nitrogen oxides. Therefore, only hydrocarbons emissions were modeled for the summer season.

Input Parameters	Area A	Area B
For use in MOBILE6.2		
IM Program	Required under ARS 49-542	Required under ARS §49-542
Registration Distribution	ADOT MVD 2003 registration data and Vehicle Emissions Inspection (VEI) statistics	Same
Calendar Year	2003	2003
Evaluation Month	July for Summer January for Winter	Same
Altitude	Low altitude	Avg. of High and Low altitude
Min/Max temperatures from National Weather Service	Summer – 75.5 / 102.5 Winter – 49.2 / 72.6	Summer – 68.0 / 96.2 Winter – 46.6 / 72.6
Fuel RVP (psi)	7.0 for Summer; 9.0 for Winter Source: Caps from ARS §41-2083; MAG CO and ozone plans	8.0 for Summer, 10.8 for Winter Source: PAG
Oxygenated fuels	2.0% O_2 for Summer; 3.5% for Winter Per standards from ARS §§ 41-2123 and 2124	0% for Summer; 1.8% for Winter Source: PAG CO Limited Maintenance Plan
Mileage Accumulation Rate	National averages from MOBILE6.2[2]	Same
IM Program Stringency - Expected failure rate(from VEI statistics)	40.6%	25.3%
IM Program Compliance Rate - % of fleet complying with program requirements	96% - MOBILE6.2 default	Same
For IM Benefits Calculations		
Area-Wide Vehicle Miles Traveled (VMT) per day	514,727miles/day*	161,772 miles/day*

*Please refer to Modeling Methodology Step #10 discussed below

Modeling Methodology Steps:

1. The registration distribution is limited to a vehicular fleet comprising of only vehicles 25 years old and older;
2. The mileage accumulation rate inputs are also adjusted to reflect only vehicles 25 years old and older;
3. The model is executed for two different scenarios:

[2] MOBILE6.2 lumps all vehicles 25 years old and older into one age cohort. Mileage accumulation rates are described within the MOBILE6.2 model as mathematical functions of vehicle age for each of over 20 different classes of vehicles (e.g., light duty vehicles, two categories of light duty trucks, heavy duty vehicles by weight class), which can be extrapolated to model years in excess of 25 years old. See "Fleet Characterization Data for MOBILE6" (EPA, September 2001).

a. Scenario 1: No IM for vehicles 25 years old and older;
b. Scenario 2: IM for vehicles 25 years old and older.
This is repeated for both Area A and Area B. For Area B, this is modeled for two altitude scenarios; consistent with PAG's modeling method and the terrain of Area B.

4. IM benefits are calculated using results from Step# 1 (a, b) - a combined emission factor for all vehicles is calculated except motorcycles (because MOBILE6.2 does not calculate IM benefit for motorcycles – IM benefits for motorcycles are added from those estimated in the motorcycle emissions analysis);

Region	**IM**(g/mile)		**No IM**(g/mile)		**IM benefit** (g/mile)	
	HC	**CO**	**HC**	**CO**	**HC**	**CO**
Area A	10.8002	26.1879	12.373	48.857	1.5728	22.6691
Area B	12.129	65.5	14.3015	100.318	2.175	34.8175

5. VMT estimation:
VMT distribution is based on EPA's "Fleet Characterization Data for MOBILE6–" (EPA, September 2001).
6. The mileage accumulation data was extrapolated to 37 years using the appropriate curve fit equations for each class of vehicles provided in the report;
7. Mileage data were mapped to vehicle categories and ages in the Registration Distribution data;
8. Registration Distribution was broken down to reflect fleet distribution by age up to model year 1967;
9. Aggregated daily average VMT was calculated for each age of vehicles and vehicle class from the weighted daily VMT obtained from Step# 7 and Step# 8;
10. Sum of all aggregated daily average VMT for each age of vehicles 25 years old and older, for all vehicle classes is the calculated VMT:
514,727miles/day for Area A and
161,772 miles/day for Area B;
11. The modeled output (grams per mile) (Step #4) was converted to tons per day by applying VMT (Step#10) for each region;

Region	**IM benefit** (g/mile)		**VMT** (miles/day)	**Tonnage reduction** (mtpd)	
	HC	**CO**		**HC**	**CO**
Area A	1.5728	22.6691	514,727	0.8096	11.6694
Area B	2.1725	34.8175	161,772	0.3514	5.6325

Motorcycle IM benefits:
Because motorcycles are not credited with IM benefits in the model, results of the IM benefit thus far obtained do not include IM benefits for motorcycles 25 years old and older. IM benefits for motorcycles, calculated from the motorcycle analysis, are therefore added to the results obtained from this analysis.

12. IM benefits for motorcycles are obtained from the motorcycle emission analysis;

Region	**Mass Emission reductions** ER_{mc} (mtpd)	
	HC	**CO**
Area A	0.1088	1.2906
Area B	0.0301	0.0931

13. From the 2003 VEI test data,

Region	Total motorcycles	Motorcycles 24 years and newer (MY 1980-2004)	Percent of MC fleet	
			24 yrs old (MY 1967-1979)	25+ yrs old
Area A	22053	20254	91.84%	8.16%
Area B	6240	5486	87.92%	12.08%

14. Applying the fraction corresponding to 25+ years (from Step #13) to the motorcycle IM benefit (Step # 12), IM benefits for motorcycles 25 years old and older are calculated as follows:

$MC_{25} * ER_{mc} = ER_{mc25}$

Where

MC_{25} = Fraction of motorcycles 25+ years old (0.0816 for Area A)

ER_{mc} = IM benefits for the entire motorcycle fleet (1.2906 metric tons per day for CO)

ER_{mc25} = IM benefits for motorcycles 25+ years old.

Region	**IM benefit for 25+ yr old MCs**(ER_{mc25} in mtpd)	
	HC	**CO**
Area A	0.0089	0.1053
Area B	0.0036	0.0113

15. This IM benefit (ERmc25) is added to the IM benefit obtained for all vehicles 25 year old and older (from Step #11)
16. This reduction is then expressed as a percentage of emissions from the onroad mobile source fleet in Maricopa and Pima counties for HC and CO respectively.

Region	**Tonnage reduction 25+ vehicles**(mtpd)		**Relative Reduction** (%)	
	HC	**CO**	**HC**	**CO**
Area A	0.8184	11.7737	1.14%	1.68%
Area B	0.3551	5.6437	1.17%	1.39%

Appendix 2b

Technical Support Document

Evaluating Emissions Impacts of Exempting Collectible Vehicles from Vehicle Emissions Inspections

Technical Support Document for Evaluating Emissions Impacts of Exempting Collectible Vehicles from Vehicle Emissions Inspections

Introduction

The modeling was performed using EPA's vehicular emission factor model, MOBILE6.2, as required by EPA in analyzing vehicular emissions.

The analysis was modeled for two seasons – winter and summer, considering the significance of the pollutants: carbon monoxide for wintertime and ozone precursors, hydrocarbons and oxides of nitrogen, for summertime. This dual modeling procedure was repeated in each of the different scenarios as described further. Also, because Maricopa County and Pima County have different travel patterns and vehicle distributions, each county was analyzed separately.

To be classified as a collectible vehicle, the vehicle needs to be at least 15 years old and meet other criteria as defined in the narrative portion of this document. Collectible vehicles are required to be covered under a collectible vehicle or classic automobile insurance policy that restricts mileage accumulation and, in addition, may not be a primary means of transport. By definition, not all 15 year-old vehicles are collectible vehicles. The absence of a category for collectible vehicles in MVD records requires other means to isolate such vehicles from a fleet of vehicles 15 years old and older.

A survey conducted by ADEQ in coordination with car clubs in Arizona provided information about the distribution of collectible cars and mileage accumulation required for this analysis. Table 1 provides a break down by model year for the 285 responses. Of these 285 responses, it was possible to identify 117 cars in the Vehicle Emissions Inspection (VEI) database. Emissions test history for these cars was analyzed to compare failure rate of collectible cars with those of cars of the same model year. Table 2 shows the failure rate of collectible cars being subject to the IM program by model year alongside the average fleet-wide failure rate for the same model years. Also analyzed from the survey was the annual mileage accumulation of collectible cars – 1,800 miles. Table 3 was developed based on information received from two of the four major insurance companies (Condon & Skelly and Hagerty) specializing in selling collectible car insurance in Arizona and from information provided by stakeholders. The average number of policies obtained from these two companies (1,776) was spread over the remaining two companies to obtain a total of 7,102 collectible cars in Arizona. But, from Table 1, we see that the percentage of collectibles undergoing emissions test is 73.33% of the total response. Therefore, the total number of collectible cars requiring emissions test is reduced to 5,208. This was further reduced to represent the collectible vehicle population in Maricopa County (Area A) and Pima County (Area B), based on the fraction of 15 year old and older LDVs in the entire fleet.

Also, for the purpose of consolidating the IM benefits of collectible cars with those of vehicles 25 years and older, it was necessary to isolate the 25 year old and older collectible cars that required emissions testing from the equation. This was done because of the fact that 25 year old and older vehicles included the 25 year old and older vehicles

from the collectible vehicle category. Thus excluding this set of collectible cars would only contain emissions from collectible cars that are 24 years old and older.

This tonnage is obtained by applying the fraction of 24 year old collectible cars in the collectible fleet (10.53%) to the emissions attributed to collectible cars.

Collectible Vehicle Survey Statistics

Table 1
Model Year Distribution

Model Year	Number of responses	Distribution
Pre-1967	76	26.67%
1967	36	12.63%
1968	31	10.88%
1969	31	10.88%
1970	31	10.88%
1971	10	3.51%
1972	10	3.51%
1973	7	2.46%
1974	8	2.81%
1975	6	2.11%
1976	5	1.75%
1977	4	1.40%
1978	5	1.75%
1979	3	1.05%
1980	6	2.11%
1981	2	0.70%
1982	4	1.40%
1983	0	0.00%
1984	2	0.70%
1985	1	0.35%
1986	4	1.40%
1987	3	1.05%
Total vehicles	**285**	**100.00%**
'67-'79 Model Years	**187**	
'67-'89 Model Years*	**209**	**73.33%**

*Number of Collectible vehicles required to pass an emissions test = 209
Number of Collectible cars 24 years and newer = 22
Percentage of collectible cars 24 years and newer = 10.53%

Table 2

Collectible cars distribution in survey and IM failure rate comparison

Model Year	Collectible Vehicle Survey Statistics			Total IM Tested Fleet Statistics	
	Number	**Distribution**	**IM Failure Rate**	**Distribution**	**IM Failure Rate** (2003 VEI Data)
1967	19	16.2%	31.58%	1.6%	44.7%
1968	17	14.5%	64.71%	1.8%	42.5%
1969	18	15.4%	50.00%	2.1%	43.9%
1970	16	13.7%	68.75%	2.2%	39.8%
1971	8	6.8%	12.50%	2.0%	38.1%
1972	7	6.0%	28.57%	3.0%	37.8%
1973	4	3.4%	50.00%	2.9%	37.1%
1974	5	4.3%	40.00%	2.4%	36.9%
1975	3	2.6%	33.33%	1.9%	43.8%
1976	0	0.0%	0.00%	3.2%	43.7%
1977	2	1.7%	50.00%	4.6%	41.1%
1978	4	3.4%	75.00%	5.5%	39.5%
1979	2	1.7%	0.00%	5.7%	42.0%
1980	3	2.6%	0.00%	3.8%	40.2%
1981	1	0.9%	0.00%	3.1%	53.1%
1982	2	1.7%	0.00%	3.7%	47.6%
1983	0	0.0%	0.00%	4.9%	47.3%
1984	1	0.9%	0.00%	7.7%	42.0%
1985	1	0.9%	0.00%	10.7%	39.5%
1986	1	0.9%	0.00%	13.2%	39.4%
1987	3	2.6%	33.33%	14.0%	34.3%
Totals & Averages	**117**	**100%**	**42.7%**	**100%**	**40.6%**
Weighted Average Failure Rate*			**42.7%**	**--**	**41.5%**

*Assumes same distribution of vehicles by model year as those in the survey.

Table 3
Collectible vehicles in Arizona

Insurance companies[3]	Number of policies in AZ
Condon & Skelly	1199
Hagerty Coll. Car Insurance	2352
American Collectors Insurance	1776*
Grundy Insurance	1776*
Total Collectible cars in AZ	**7102**

*Average of the number of policies sold in Arizona by Condon & Skelly and Hagerty insurance companies.

Modeling methodology

MOBILE6.2 requires the following inputs in order to estimate the required emissions:

Input Parameters	Area A	Area B
For use in MOBILE6.2		
IM Program	Required under ARS 49-542	Required under ARS §49-542
Registration Distribution	ADOT MVD 2003 registration data and Vehicle Emissions Inspection (VEI) statistics	Same
Calendar Year	2003	2003
Evaluation Month	July for Summer January for Winter	Same
Altitude	Low altitude	Avg. of Low and High altitudes
Min/Max temperatures from National Weather Service	Summer – 75.5 / 102.5 Winter – 49.2 / 72.6	Summer – 68.0 / 96.2 Winter – 46.6 / 72.6
Fuel RVP (psi)	7.0 for Summer; 9.0 for Winter Source: Caps from ARS §41-2083; MAG CO and Ozone plans	8.0 for Summer; 10.8 for Winter Source: PAG
Oxygenated fuels	2.0% O_2 for Summer; 3.5% for Winter Per standards from ARS §§ 41-2123 and 2124	0% for Summer; 1.8% for Winter Source: PAG CO Limited Maintenance Plan

[3] Major insurance companies providing automobile insurance for classic/collectible cars in Arizona.

Input Parameters	Area A	Area B
Mileage Accumulation Rate	National averages from MOBILE6.2[4]	Same
IM Program Stringency - Expected failure rate	2003 ADEQ VEI statistics	Same
IM Program Compliance Rate - % of fleet complying with program requirements	96% - MOBILE6.2 default	Same
Area-Wide Vehicle Miles Traveled (VMT) per day	18,788 miles*	6,896 miles*

* Please refer to Modeling Methodology Step #13 in "Modeling Methodology Steps" discussed herein under

The analysis involves estimating the emission factor for Light Duty Vehicles (LDVs) for two modeling scenarios, namely, with and without an Inspection and Maintenance (IM) program in place. The model was executed for two test types – the idle test and the IM 147 test. The difference between the resulting emission factors from the two scenarios is the IM benefit for LDVs.

IM Benefit = EF_{IM} - $EF_{No\ IM}$,
Where:
EF_{IM} = Emission factor with IM program in place
$EF_{No\ IM}$ = Emission without IM program in place.
Essentially, the IM benefit was estimated for the category of vehicles 15 years old and older and the fraction of collectible vehicles in the fleet was applied to this reduction as the contributing percentage to the reduction (IM benefit) obtained from the model. This is the IM benefit for Collectible vehicles.

Modeling Methodology Steps:

1. Registration distribution and VMT fractions were modified to model only a fleet of 15 year old light duty vehicles;
2. Two MOBILE6.2 runs were executed for Maricopa County (Area A) and Pima County (Area B) respectively. For Area B, this is modeled for two altitude scenarios, consistent with PAG's modeling method and the terrain of Area B:
   For fleet of vehicles 15 years old and older with and without IM in place;
3. IM benefit was calculated using results from Step # 2;

[4] MOBILE6.2 lumps all vehicles 25 years old and older into one age cohort. Mileage accumulation rates are described within the MOBILE6.2 model as mathematical functions of vehicle age for each of over 20 different classes of vehicles (e.g., light duty vehicles, two categories of light duty trucks, heavy duty vehicles by weight class), which can be extrapolated to model years in excess of 25 years old. See "Fleet Characterization Data for MOBILE6" (EPA, September 2001).

Region	**IM** (g/mile)		**No IM**(g/mile)		**IM Benefit**(g/mile)	
	HC	**CO**	**HC**	**CO**	**HC**	**CO**
Area A	6.1597	36.4440	7.9437	53.4180	1.7841	16.9740
Area B	6.6656	52.6512	8.4207	72.8064	1.7551	20.1552

Collectible vehicle population determination:

It was assumed that collectible vehicles were distributed between the two counties in the same proportion as vehicles 15 years old and older in the registration distribution of the respective county.
Number of vehicles in the desired fleet (15 years old and older):
Area A: 274,018 vehicles
Area B: 100,567 vehicles

4. Fraction of 15 + year old vehicles in Area A = 274,018/(100,567+274,018) = 0.7315
5. Fraction of 15 + year old vehicles in Area B = (1-Step #4) = 0.2685;

From the survey:

6. It was also estimated that 26.7% of the collectible cars were older than model year 1967 and therefore, not subject to the IM program;
7. Number of vehicles possessing collectible vehicle insurance policy = 7,102;
8. Percent of collectible vehicles subject to the IM program= 73.3%(From Step #6);
9. Number of collectible vehicles required to go through the emissions test = 0.7333*7,102 = 5,208;
10. Number of collectible vehicles in Area A = 0.7315*5,208 = 3,810 (From Step #4);
11. Number of collectible vehicles in Area B = 5,195-3,819 = 1,398 (assuming the remaining are in Area B);

VMT Estimation:

VMT for collectible cars was based on average annual VMT obtained from survey (1,800 miles per vehicle);

12. Daily VMT for collectible vehicles requiring emissions testing in Area A = 3,810*1,800/365 = 18,788 miles (from Step #10);
    Similarly, VMT was derived for Area B (from Step #11);
    VMT for Area B = 6,894 miles;

Mass emissions:

13. Emission rate obtained from Step # 3 (IM benefit) was multiplied by the VMT for Collectible vehicles in Area A and Area B respectively (Step #12), to estimate IM benefits in mass emissions (tons per day);

14. Results from Step # 13 were expressed as a percentage reduction in relation to the emissions from the entire fleet of vehicles in Maricopa and Pima counties respectively.

Region	**IM Benefits** (mtpd)		**Relative reduction** (%)	
	HC	**CO**	**HC**	**CO**
Area A	0.0335	0.3189	0.0466	0.0456
Area B	0.0121	0.1390	0.0400	0.0342

For the purpose of consolidating emissions from collectible cars with those from the fleet of vehicles 25 years and older, the following steps were necessary, in order to not include emissions from 25 year old and older collectible cars that were already modeled with the 25 year old and older vehicles:

15. Cars 24 years old and newer : 22 (from survey)
16. Percent of 24 year old collectible cars in the fleet of collectible cars: (22/209) = 10.53% (from Table 1)
17. This percentage was applied to IM benefits for collectible cars (Step #13)

Region	**IM Benefit for 24 year old and newer**	
	HC	**CO**
Area A	0.0035	0.0336
Area B	0.0013	0.0146

Appendix 2c

Technical Support Document

Evaluating Emissions Impacts of Exempting Motorcycles from Vehicle Emissions Inspections

Technical Support Document for Evaluating Emissions Impacts of Exempting Motorcycles from Vehicle Emissions Inspections

Introduction

The modeling was performed using EPA's vehicular emission factor model, MOBILE6.2, as required by EPA in analyzing vehicular emissions. This analysis was modeled for two seasons – winter and summer, considering the significance of the two pollutants - carbon monoxide and hydrocarbons[5] which are typically wintertime and summertime pollutants respectively. This dual modeling procedure was repeated in each of the different situations as described further. Also, because Maricopa County and Pima County have different travel patterns and vehicle distributions, each county was analyzed separately.

As discussed in the modeling protocol narrative, because MOBILE6.2 is not designed to calculate credits for an Inspection and Maintenance (IM) program for motorcycles, motorcycles were treated as Light Duty Vehicles (LDV) because LDVs 1980 and older in Maricopa County and motorcycles are both subject to the same type of test, the idle test. In Pima County, LDVs of all model years are subject to the same type of test as motorcycles – the idle test.

In order to estimate IM credits for motorcycles, LDV data could be substituted with motorcycle data in the model, for IM and non-IM scenarios. This would provide the modeled IM benefits or the emission reduction (the reduction in emissions by subjecting a fleet to the IM program) for the motorcycle fleet. But due to inherent differences in construction and functioning between motorcycles and LDVs, reductions obtained from the MOBILE6.2 modeling for LDVs would not be directly applicable to motorcycles. In addition, VEI records show that IM benefits from testing motorcycles is not equal to that of LDVs. Therefore, after the modeled IM benefits were calculated, a correction factor was applied, using VEI test data. This derivation is explained in detail later in this section. The correction factor was multiplied by the modeling results for the final answer.

In summary, the analysis comprises of two components:

1. MOBILE6.2 was executed for Maricopa County (Area A) and Pima County (Area B), each with and without IM for VOC (summer) and CO (winter) to determine IM benefits for a season day for motorcycles (substituting motorcycle data for LDVs). For Area B, this is modeled for two altitude scenarios, consistent with PAG's modeling method and the terrain of Area B;
2. Calculate and apply the correction factor to adjust the modeling results to determine accurate emission changes from exempting motorcycles.

[5] Although hydrocarbons and nitrogen oxides are both precursors to ozone, nitrogen oxides are not tested for in the motorcycle emissions testing process. Therefore, only hydrocarbons were modeled for the summer season.

The same can be explained by the following equation:

$ER_{mc} = MC_{reduction} \times VMT_{mc} \times VMT_{total} \times CF$
Where:
ER_{mc} = Emission reduction for motorcycles;
$MC_{reduction}$ = Modeled motorcycle emission rate reduction;
VMT_{mc} = VMT fraction for the motorcycle fleet;
VMT_{total} = Total VMT of the entire fleet;
CF = Correction Factor

In addition, HB 2294 required IM benefits of motorcycles are consolidated with those of vehicles 25 years old and older. Therefore, a fractional distribution of 25 year old and older and 24 year old and newer was obtained using VEI's IM test data. The fraction corresponding to the 25 year old and older motorcycles was applied to the IM benefits of motorcycles and consolidated with those of 25+ year old vehicles.

Modeling:

In order to maintain consistency with the modeled data used by the Maricopa Association of Governments (MAG) and Pima Association of Governments (PAG) in their SIPs, wherever applicable, those data were replicated. The following table shows a list of MOBILE6.2 inputs and their source.

Input Parameters	Area A	Area B
For use in MOBILE6.2		
IM Program	Required under ARS 49-542	Required under ARS §49-542
Registration Distribution	ADOT MVD 2003 registration data and Vehicle Emissions Inspection (VEI) statistics	Same
Calendar Year	2003	2003
Evaluation Month	July for Summer January for Winter	Same
Altitude	Low altitude	Avg. of Low and High altitudes
Min/Max temperatures from National Weather Service	Summer – 75.5 / 102.5 Winter – 49.2 / 72.6	Summer – 68.0 / 96.2 Winter – 46.6 / 72.6
Fuel RVP (psi)	7.0 for Summer; 9.0 for Winter Source: Caps from ARS §41-2083; MAG CO and ozone plans	8.0 for Summer; 10.8 for Winter Source: PAG
Oxygenated fuels	2.0% O_2 for Summer; 3.5% for Winter Per standards from ARS §§	0% for Summer; 1.8% for Winter Source: PAG CO Limited

Input Parameters	Area A	Area B
	41-2123 and 2124	Maintenance Plan
Mileage Accumulation Rate	National averages from MOBILE6.2[6]	Same
IM Program Stringency - Expected failure rate(from VEI statistics)	40%	26.7%
IM Program Compliance Rate - % of fleet complying with program requirements	96%	97%
For IM Benefits Calculations		
Area-Wide Vehicle Miles Traveled (VMT) per day	68,000,000miles/day Source (MAG)	19,382,125 miles/day Source: PAG

The following steps were performed separately for CO (winter) and HC (summer) for each scenario, namely IM and No IM and for both Maricopa County and Pima County.

Modeling Methodology Steps:

1. Develop a data set of registration distribution and annual mileage accumulation for motorcycles in place of LDVs;
2. Replace starts per day inputs to reflect motorcycles;
3. Run MOBILE6.2 model for 4 scenarios:
   a) IM and No-IM, substituting motorcycle registration and miles distribution with a surrogate LDV data for summer (HC) for Maricopa County and Pima County.
   b) IM and No-IM, substituting motorcycle registration and miles distribution with a surrogate LDV data for winter (CO) for Maricopa County and Pima County.
4. Determine the modeled reduction in emission rate (No IM – IM) for motorcycles for HC and CO respectively (interpreted by the model as LDV);

$$MC_{reduction} = \text{No IM} - \text{IM};$$

Where

$MC_{reduction}$ = Modeled reduction in emission rate;

[6] MOBILE6.2 lumps all vehicles 25 years old and older into one age cohort. Mileage accumulation rates are described within the MOBILE6.2 model as mathematical functions of vehicle age for each of over 20 different classes of vehicles (e.g., light duty vehicles, two categories of light duty trucks, heavy duty vehicles by weight class), which can be extrapolated to model years in excess of 25 years old. See "Fleet Characterization Data for MOBILE6" (EPA, September 2001).

Region	**IM**(g/mile)		**No IM**(g/mile)		**IM Benefit** $MC_{reduction}$(g/mile)	
	HC	**CO**	**HC**	**CO**	**HC**	**CO**
Area A	1.94	13.42	2.37	18.92	0.43	5.50
Area B	1.97	18.08	2.36	24.08	0.39	6.01

Derivation of motorcycle emission correction factor:

Using VEI test lane data:

5. Sum of measured emissions for each model year for the respective vehicle category (LDV and motorcycles) for both, passed and failed vehicles is calculated:
   (Total Emissions$_{LDV}$, Total Emissions $_{mc}$);
6. Excess Emissions = Measured emissions from failed vehicles - Cutpoint
7. Calculate sum of excess emissions for each model year = (Total Excess Emissions) based on the cutpoint standard applicable for the respective vehicle category (LDV and motorcycles) and model year;
8. Calculate IM benefit for each model year for LDVs and motorcycles respectively;
   IM Reduction =Total Emissions– Total Excess Emissions
   IM reduction for motorcycles = IM reduction $_{mc}$,
   IM reduction for light duty vehicles = IM reduction $_{LDV}$;
9. Normalize Fleet distribution for LDVs (FD_{ldv}) and motorcycles (FD_{mc}) by model year;
10. A distribution factor by model year of MC to LDV is calculated to determine the ratio of the number of LDVs to the number of MCs tested for a given model year, DF;
    Where $DF = FD_{mc}/ FD_{ldv}$;
11. This is applied to the number of LDVs of that model year tested, to derive a number equivalent to MCs of the same model year;
12. This factor is also applied to the measured excess HC to calculate the adjusted excess HC for all LDVs of a given model year;
13. Average excess HC for LDVs is calculated from Step #11 (I/M reduction $_{ldv\text{-}hc}$);
14. Similarly, average excess HC is calculated for MCs, using measured results I/M reduction $_{mc\text{-}hc}$);
15. Steps #9~14 are repeated for excess CO;
16. Motorcycle Reduction Fraction (MCR) = $\frac{\text{I/M reduction}_{mc}}{\text{I/M reduction}_{LDV}}$
17. Correction Factor (CF)= $\sum_{1967}^{1980} \text{MCR}_{wtd}$ where
    The Correction Factor = Sum of all weighted MCR from model year 1967 through 1999;

Region	Correction Factor	
	HC	CO
Area A	0.75	0.69
Area B	0.80	0.16

18. The correction factor obtained from Step #17 is applied to the modeled IM benefits for HC and CO for Area A and Area B (because modeled reduction is an emission factor for LDV, using motorcycle data):

$EF_{adj} = MC_{reduction} \times CF$

Where EF_{adj} = Adjusted Emission factor;
$MC_{reduction}$ = Modeled motorcycle reduction factor (from Step # 4);
CF = Correction Factor (from Step # 17)

Region	Adjusted Emission factor EFadj(g/mile)	
	HC	CO
Area A	0.32	3.80
Area B	0.31	0.96

19. Mass Emission reductions for motorcycles:

$ER_{mc} = EF_{adj} \times VMT_{mc} \times VMT_{total}$

Where ER_{mc} = Mass emission reduction from motorcycle
EF_{adj} = Adjusted Emission factor (from Step # 18);
VMT_{mc} = Vehicle Miles Traveled fraction for motorcycles (0.005);
VMT_{total} = Total Vehicle Miles Traveled (68,000,000);

Region	Mass Emission reductions ER_{mc} in mtpd*	
	HC	CO
Area A	0.1088	1.2906
Area B	0.0301	0.0931

*metric tons per day

20. Reductions expressed as a percentage of area-wide onroad emissions:

Percentage reduction = ($MC_{reduction}$ /Total onroad emissions) x 100
Where $MC_{reduction}$ = Mass emission reductions for motorcycles (from Step # 19);
Total emissions = Emissions obtained from emissions inventory from MAG's reports[7] and PAG.

[7] 1. Carbon Dioxide Redesignation Request and Maintenance Plan for the Maricopa County Nonattainment Area
2. One-Hour Ozone Redesignation Request and Maintenance Plan for the Maricopa County Nonattainment Area

Region	IM Benefit (ER_{mc} in mtpd)		Relative Reduction (%)	
	HC	CO	HC	CO
Area A	0.1088	1.2906	0.15%	0.18%
Area B	0.0301	0.0931	0.10%	0.02%

For the purpose of consolidating emissions from motorcycles with those from the fleet of vehicles 25 years and older, the following steps were necessary, in order to not include emissions from 25 year old and older motorcycles that were already included with the 25 year old and older vehicles:

21. A fractional distribution of 24 year old and newer motorcycles was determined from the motorcycle fleet using VEI test data:

Region	Total # of motorcycles	24 yrs old motorcycles	Percent of total motorcycles	
			24 year old and newer	25+ yr old
Area A	22053	20254	91.84%	8.16%
Area B	6240	5486	87.92%	12.08%

22. The fraction corresponding to the 25 year old motorcycles was applied to the IM benefit for motorcycles:

$$ER_{mc*} MC_{25} = ER_{mc25}$$

Where

ER_{mc} = Mass Emission reduction for motorcycles;
MC_{25} = Fraction of motorcycles 25 years old and older;
ER_{mc25} = Mass Emissions of motorcycles 25 years old and older.

Region	HC	CO
Area A	0.0089	0.1053
Area B	0.0036	0.0113

Appendix 3

Examples of Modeling

Input and Output Files

Appendix 3a

Input Files

Appendix 3a(1)

Input Files

Vehicles 25 Years Old and Older with IM for

Calendar Year 2003 – Summer, Area B

*Area B vehicles 25 yrs old and older with IM Low Altitude

********** HEADER SECTION **********
MOBILE6 INPUT FILE
POLLUTANTS : HC
DAILY OUTPUT :
DATABASE OUTPUT :
WITH FIELDNAMES :
RUN DATA :

********** RUN SECTION **********
VMT FRACTIONS :
0.380 0.115 0.322 0.117 0.066 0.0 0.00 0.00
0.00 0.00 0.00 0.0 0.0 0.00 0.00 0.00
FUEL RVP : 8.0
MIN/MAX TEMPERATURE: 68.0 96.2
NO REFUELING :
REG DIST : D:\Models\M62\Mobile6\Run\a25.d
MILE ACCUM RATE : D:\Models\M62\Mobile6\Run\Mileage.d
I/M DESC FILE : D:\Models\M62\Mobile6\Run\BS25YRIM.d
ANTI-TAMP PROG :
87 75 95 22222 22222222 2 11 096. 22111112
********** SCENARIO SECTION **********

SCENARIO RECORD : Area B vehicles 25 yrs old and older with IM CY2003
CALENDAR YEAR : 2003
EVALUATION MONTH : 7
ALTITUDE : 1
ABSOLUTE HUMIDITY : 55.7

********** END OF RUN **********
END OF RUN :

Appendix 3a(2)

Input Files

Collectible Vehicles with IM for

Calendar Year 2003 – Summer, Area A

* Summertime VOC Emissions for Collectible vehicle fleet
* in Area A with IM 2003 Low Altitude

********** Header Section **********
MOBILE6 INPUT FILE :
POLLUTANTS : HC
DATABASE OUTPUT :
WITH FIELDNAMES :
DAILY OUTPUT :
RUN DATA :

********** Run Section **********
REG DIST : D:\Models\M62\Mobile6\Run\acollect.d
VMT FRACTIONS :
0.380 0.115 0.322 0.117 0.066 0.0 0.00 0.00
0.00 0.00 0.00 0.0 0.0 0.00 0.00 0.00
I/M DESC FILE : D:\Models\M62\Mobile6\Run\AColIM.d
ANTI-TAMP PROG :
87 75 80 22222 22222222 2 11 097. 22111222
ANTI-TAMP PROG :
87 81 95 11111 22222222 2 11 097. 22111222

********** Scenario Section **********

SCENARIO RECORD : Summer VOC emissions in Area A with I/M2003
CALENDAR YEAR : 2003
MIN/MAX TEMP : 75.5 102.5
FUEL RVP : 7.0
SULFUR CONTENT : 30

FUEL PROGRAM : 4
30.0 30.0 30.0 30.0 30.0 30.0 30.0 30.0
30.0 30.0 30.0 30.0 30.0 30.0 30.0 30.0
80.0 80.0 80.0 80.0 80.0 30.0 30.0 30.0
30.0 30.0 30.0 30.0 30.0 30.0 30.0 30.0
OXYGENATED FUELS : 1.000 0.000 0.020 0.000 1
EVALUATION MONTH : 7

********** End of This Run **********

Appendix 3a(3)

Input Files

Motorcycle Emissions without IM for

Calendar Year 2000 – Winter, Area B

```
* Wintertime CO Emissions for m/c fleet
* in Area B without IM Low Altitude

***************     Header Section     ***************
MOBILE6 INPUT FILE :
POLLUTANTS        : CO
DAILY OUTPUT      :
DATABASE OUTPUT   :
WITH FIELDNAMES   :
DATABASE VEHICLES  : 22111 11111111 1 111 11111111 111
RUN DATA          :

***************     Run Section     ***************
REG DIST          : D:\Models\M62\Mobile6\Run\bmc00.d
STARTS PER DAY    : D:\Models\M62\Mobile6\Run\mcstpd.d

***************     Scenario Section     ***************
SCENARIO RECORD   : Winter CO emissions in Area B without I/M2000
CALENDAR YEAR     : 2000
MIN/MAX TEMP      : 46.6 72.6
FUEL RVP          : 10.8
SULFUR CONTENT    : 30
FUEL PROGRAM      : 4
  30.0  30.0  30.0  30.0  30.0  30.0   30.0   30.0
  30.0  30.0  30.0  30.0  30.0  30.0   30.0   30.0
  80.0  80.0  80.0  80.0  80.0  30.0   30.0   30.0
  30.0  30.0  30.0  30.0  30.0  30.0   30.0   30.0
OXYGENATED FUELS  : 0.000 1.000 0.000 0.018 1
EVALUATION MONTH  : 1

***************     End of This Run     ***************
END OF RUN        :
```

Appendix 3a(4)

Input Files

Motorcycle Registration Distributions for

Areas A and B – Calendar Year 2003

REG DIST

*Area A M/C registration distribution used as LDV for Calendar Year 2003

* LDV

1	0.029	0.112	0.110	0.096	0.084	0.068	0.055	0.051	0.042	0.045
	0.037	0.030	0.030	0.026	0.022	0.020	0.023	0.025	0.020	0.014
	0.014	0.017	0.012	0.012	0.007					

REG DIST

*Area B M/C registration distribution used as LDV for Calendar Year 2003

* LDV

1	0.014	0.091	0.091	0.113	0.098	0.084	0.085	0.070	0.060	0.049
	0.036	0.030	0.025	0.024	0.018	0.014	0.015	0.018	0.019	0.018
	0.010	0.004	0.002	0.002	0.007					

Appendix 3a(5)

Input Files

IM Descriptive Files - Area B

*AREA B I/M

* 1ST I/M PROGRAM
I/M PROGRAM : 1 1977 2050 1 T/O IDLE
I/M MODEL YEARS : 1 1967 1980
I/M VEHICLES : 1 22222 22222222 2
I/M STRINGENCY : 1 26.7
I/M COMPLIANCE : 1 97.0
I/M WAIVER RATES : 1 2.0 1.0

* 2ND I/M PROGRAM
I/M PROGRAM : 2 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS : 2 1981 1995
I/M VEHICLES : 2 22222 22222222 2
I/M STRINGENCY : 2 26.7
I/M COMPLIANCE : 2 97.0
I/M WAIVER RATES : 2 2.0 1.0

* 3RD I/M PROGRAM
I/M PROGRAM : 3 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS : 3 1996 2050
I/M VEHICLES : 3 11111 22222222 2
I/M STRINGENCY : 3 26.7
I/M COMPLIANCE : 3 97.0
I/M WAIVER RATES : 3 2.0 1.0

*4TH I/M PROGRAM
I/M PROGRAM : 4 1977 2050 1 T/O GC
I/M MODEL YEARS : 4 1967 1995
I/M VEHICLES : 4 22222 22222222 2
I/M COMPLIANCE : 4 97.0
I/M WAIVER RATES : 4 2.0 1.0

* 5TH I/M PROGRAM
I/M PROGRAM : 5 1977 2050 1 T/O GC
I/M MODEL YEARS : 5 1996 2050
I/M VEHICLES : 5 11111 22222222 2
I/M COMPLIANCE : 5 97.0
I/M WAIVER RATES : 5 2.0 1.0

*6TH I/M PROGRAM
I/M PROGRAM : 6 2002 2050 1 T/O OBD I/M
I/M MODEL YEARS : 6 1996 2050
I/M VEHICLES : 6 22222 11111111 1
I/M STRINGENCY : 6 26.7
I/M COMPLIANCE : 6 97.0
I/M WAIVER RATES : 6 2.0 1.0
I/M GRACE PERIOD : 6 5

* 7TH I/M PROGRAM
I/M PROGRAM : 7 2002 2050 1 T/O EVAP OBD & GC
I/M MODEL YEARS : 7 1996 2050
I/M VEHICLES : 7 22222 11111111 1
I/M COMPLIANCE : 7 97.0
I/M WAIVER RATES : 7 2.0 1.0
I/M GRACE PERIOD : 7 5

Appendix 3b

Output Files

Appendix 3b(1)

Output Files

Vehicles 25 Years Old and Older with IM for

Calendar Year 2003 – Summer, Area B

```
*****************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                                *
* Input file: BS25YIM.IN (file 1, run 1).                                   *
*****************************************************************************
  M615 Comment:
               User supplied VMT mix.
  M603 Comment:
               User has disabled the calculation of REFUELING emissions.


* Reading Registration Distributions from the following external
* data file: D:\MODELS\M62\MOBILE6\RUN\A25.D

* Reading non-default MILEAGE ACCUMULATION RATES from the following external
* data file: D:\MODELS\M62\MOBILE6\RUN\MILEAGE.D

* Reading I/M program description records from the following external
* data file: D:\MODELS\M62\MOBILE6\RUN\BS25YRIM.D
  M 21 Warning:
                Mileage accumulation missing for one age of LDGV
* # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # #
* Area B vehicles 25 yrs old and older with IM CY2003
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # #
*** I/M credits for Tech1&2 vehicles were read from the following external
    data file: TECH12.D
  M 48 Warning:
              there are no sales for vehicle class HDGV8b
  M 48 Warning:
              there are no sales for vehicle class HDDV2b
  M 48 Warning:
              there are no sales for vehicle class HDDV3
  M 48 Warning:
              there are no sales for vehicle class HDDV4
  M 48 Warning:
              there are no sales for vehicle class HDDV5



                    Calendar Year:  2003
                           Month:  July
```

Altitude:	Low
Minimum Temperature:	68.0 (F)
Maximum Temperature:	96.2 (F)
Absolute Humidity:	56. grains/lb
Nominal Fuel RVP:	8.0 psi
Weathered RVP:	7.5 psi
Fuel Sulfur Content:	259. ppm
Exhaust I/M Program:	Yes
Evap I/M Program:	Yes
ATP Program:	Yes
Reformulated Gas:	No

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.3698	0.4245	0.1828		0.0000	0.0102	0.0127	0.0000	0.0000	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	8.981	13.914	9.493	12.583	0.000	0.594	2.005	0.000	0.00	10.994

Appendix 3b(2)

Output Files

Collectible Vehicles with IM for

Calendar Year 2003 – Summer, Area A

```
***************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                              *
* Input file: ASCOLI.IN (file 1, run 1).                                  *
***************************************************************************

* Reading Registration Distributions from the following external
* data file: D:\MODELS\M62\MOBILE6\RUN\ACOLLECT.D
  M 49 Warning:
                0.000     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.000     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.000     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.000     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.000     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.000     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.000     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.000     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.000     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.000     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.000     MYR sum not = 1. (will normalize)
  M615 Comment:
               User supplied VMT mix.

* Reading I/M program description records from the following external
* data file: D:\MODELS\M62\MOBILE6\RUN\ACOLIM.D

* Reading non-default I/M CUTPOINTS from the following external
* data file: D:\MODELS\M62\MOBILE6\RUN\CUTPOINT.D
  M 22 Warning:
                Age distribution is zero for class HDGV2b
  M 22 Warning:
                Age distribution is zero for class HDGV3
```

```
  M 22 Warning:
               Age distribution is zero for class HDGV4
  M 22 Warning:
               Age distribution is zero for class HDGV5
  M 22 Warning:
               Age distribution is zero for class HDGV6
  M 22 Warning:
               Age distribution is zero for class HDGV7
  M 22 Warning:
               Age distribution is zero for class HDGV8a
  M 22 Warning:
               Age distribution is zero for class HDGV8b
  M 22 Warning:
               Age distribution is zero for class LDDV
  M 22 Warning:
               Age distribution is zero for class LDDT12
  M 22 Warning:
               Age distribution is zero for class HDDV2b

* # # # # # # # # # # # # # # # # # # # # # # # # # # # #
* Summer VOC emissions in Area A with I/M2003
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # # # # #

          User supplied gasoline sulfur content =  30.0 ppm.

  M616 Comment:
              User has supplied post-1999 sulfur levels.
*** I/M credits for Tech1&2 vehicles were read from the following external
    data file: TECH12.D
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

                  Calendar Year:  2003
                          Month:  July
                       Altitude:  Low
             Minimum Temperature:  75.5 (F)
             Maximum Temperature: 102.5 (F)
               Absolute Humidity:   75. grains/lb
                Nominal Fuel RVP:   7.0 psi
                   Weathered RVP:   6.4 psi
```

Fuel Sulfur Content: 30. ppm

Exhaust I/M Program: Yes
Evap I/M Program: Yes
ATP Program: Yes
Reformulated Gas: No

Ether Blend Market Share: 1.000
Ether Blend Oxygen Content: 0.020
Alcohol Blend Market Share: 0.000
Alcohol Blend Oxygen Content: 0.000
Alcohol Blend RVP Waiver: No

Vehicle Type: / GVWR:	LDGV	LDGT12 <6000	LDGT34 >6000	LDGT (All)	HDGV	LDDV	LDDT	HDDV	MC	All Veh
VMT Distribution:	0.3773	0.4337	0.1812		0.0000	0.0027	0.0050	0.0000	0.0000	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	4.323	7.121	7.819	7.327	0.000	1.004	2.681	0.000	0.00	6.153

Appendix 3b(3)

Output Files

Motorcycle Emissions without IM for

Calendar Year 2000 – Winter, Area B

```
*****************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                                *
* Input file: BNIM00W.IN (file 1, run 1).                                   *
*****************************************************************************

* Reading Registration Distributions from the following external
* data file: D:\MODELS\M62\MOBILE6\RUN\BMC00.D

* Reading start Starts/day distribution from the following external
* data file: D:\MODELS\M62\MOBILE6\RUN\MCSTPD.D

* # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # #
* Winter CO emissions in Area B without I/M2000
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # # #
         User supplied gasoline sulfur content =  30.0 ppm.
  M616 Comment:
              User has supplied post-1999 sulfur levels.
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

                   Calendar Year:  2000
                           Month:  Jan.
                        Altitude:  Low
             Minimum Temperature:  46.6 (F)
             Maximum Temperature:  72.6 (F)
               Absolute Humidity:   75. grains/lb
                Nominal Fuel RVP:   10.8 psi
                   Weathered RVP:   10.8 psi
             Fuel Sulfur Content:   30. ppm

             Exhaust I/M Program:  No
                Evap I/M Program:  No
                     ATP Program:  No
                Reformulated Gas:  No

   Ether Blend Market Share: 0.000       Alcohol Blend Market Share: 1.000
   Ether Blend Oxygen Content: 0.000     Alcohol Blend Oxygen Content: 0.018
                                          Alcohol Blend RVP Waiver: No

       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC   All Veh
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GVWR:	<6000	>6000	(All)						
VMT Distribution:	0.5162	0.2708	0.0925	0.0342	0.0010	0.0015	0.0779	0.0060	1.0000

Composite Emission Factors (g/mi):

Composite CO :	7.67	19.21	28.89	21.68	22.87	1.656	1.740	4.251	10.80	13.014

FILE	RUN	SCEN	POL	VTYPE	ETYPE	FTYPE	AGE	GM_MILE	GM_DAY	STARTS	ENDS	MILES
MPG	FACVMT		REGDIST		VCOUNT		MYR					
1	1	1	2	1	1	1	24	34.1021	429.706	1.3500	0.9974	12.6006
14.80	0.3421		0.0033		113.8595		1976					
1	1	1	2	1	1	2	24	29.8616	376.273	1.3500	0.9974	12.6006
14.80	0.4978		0.0033		113.8595		1976					
1	1	1	2	1	1	3	24	33.5869	423.214	1.3500	0.9974	12.6006
14.80	0.1305		0.0033		113.8595		1976					
1	1	1	2	1	1	4	24	38.2761	482.300	1.3500	0.9974	12.6006
14.80	0.0297		0.0033		113.8595		1976					
1	1	1	2	1	2	5	24	15.0145	189.191	1.3500	0.9974	12.6006
14.80	1.0000		0.0033		113.8595		1976					
1	1	1	2	1	1	1	23	41.2570	546.851	1.3500	0.9974	13.2548
15.50	0.3421		0.0055		113.8595		1977					
1	1	1	2	1	1	2	23	36.3341	481.599	1.3500	0.9974	13.2548
15.50	0.4978		0.0055		113.8595		1977					
1	1	1	2	1	1	3	23	41.0679	544.344	1.3500	0.9974	13.2548
15.50	0.1305		0.0055		113.8595		1977					
1	1	1	2	1	1	4	23	45.3816	601.521	1.3500	0.9974	13.2548
15.50	0.0297		0.0055		113.8595		1977					
1	1	1	2	1	2	5	23	15.4947	205.379	1.3500	0.9974	13.2548
15.50	1.0000		0.0055		113.8595		1977					
1	1	1	2	1	1	1	22	40.5613	565.526	1.3500	0.9974	13.9425
16.80	0.3421		0.0066		113.8595		1978					
1	1	1	2	1	1	2	22	35.6528	497.088	1.3500	0.9974	13.9425
16.80	0.4978		0.0066		113.8595		1978					
1	1	1	2	1	1	3	22	40.2536	561.236	1.3500	0.9974	13.9425
16.80	0.1305		0.0066		113.8595		1978					
1	1	1	2	1	1	4	22	44.5693	621.407	1.3500	0.9974	13.9425
16.80	0.0297		0.0066		113.8595		1978					
1	1	1	2	1	2	5	22	14.4552	201.542	1.3500	0.9974	13.9425
16.80	1.0000		0.0066		113.8595		1978					
1	1	1	2	1	1	1	21	40.0159	586.922	1.3500	0.9974	14.6672
17.10	0.3421		0.0097		113.8595		1979					
1	1	1	2	1	1	2	21	35.0942	514.735	1.3500	0.9974	14.6672
17.10	0.4978		0.0097		113.8595		1979					

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  1     1     1    2       1      1     3     21      39.5857       580.612     1.3500       0.9974       14.6672
17.10    0.1305       0.0097       113.8595   1979
  1     1     1    2       1      1     4     21      43.9199       644.182     1.3500       0.9974       14.6672
17.10    0.0297       0.0097       113.8595   1979
  1     1     1    2       1      2     5     21      13.5049       198.079     1.3500       0.9974       14.6672
17.10    1.0000       0.0097       113.8595   1979
  1     1     1    2       1      1     1     20      27.9992       431.978     1.3500       0.9974       15.4283
19.80    0.3421       0.0032       113.8595   1980
  1     1     1    2       1      1     2     20      23.6282       364.543     1.3500       0.9974       15.4283
19.80    0.4978       0.0032       113.8595   1980
  1     1     1    2       1      1     3     20      26.0528       401.950     1.3500       0.9974       15.4283
19.80    0.1305       0.0032       113.8595   1980
  1     1     1    2       1      1     4     20      31.2506       482.142     1.3500       0.9974       15.4283
19.80    0.0297       0.0032       113.8595   1980
  1     1     1    2       1      2     5     20      12.2024       188.262     1.3500       0.9974       15.4283
19.80    1.0000       0.0032       113.8595   1980
  1     1     1    2       1      1     1     19      40.4363       656.242     1.3500       0.9974       16.2290
21.20    0.3421       0.0031       113.8595   1981
  1     1     1    2       1      1     2     19      34.9249       566.797     1.3500       0.9974       16.2290
21.20    0.4978       0.0031       113.8595   1981
  1     1     1    2       1      1     3     19      39.5495       641.849     1.3500       0.9974       16.2290
21.20    0.1305       0.0031       113.8595   1981
  1     1     1    2       1      1     4     19      44.9206       729.018     1.3500       0.9974       16.2290
21.20    0.0297       0.0031       113.8595   1981
  1     1     1    2       1      2     5     19       4.5846        74.403     1.3500       0.9974       16.2290
21.20    1.0000       0.0031       113.8595   1981
  1     1     1    2       1      1     1     18      40.9943       699.809     1.3500       0.9974       17.0709
22.00    0.3421       0.0052       113.8595   1982
  1     1     1    2       1      1     2     18      35.1205       599.539     1.3500       0.9974       17.0709
22.00    0.4978       0.0052       113.8595   1982
  1     1     1    2       1      1     3     18      39.6277       676.480     1.3500       0.9974       17.0709
22.00    0.1305       0.0052       113.8595   1982
  1     1     1    2       1      1     4     18      44.9996       768.183     1.3500       0.9974       17.0709
22.00    0.0297       0.0052       113.8595   1982
  1     1     1    2       1      2     5     18       4.3353        74.007     1.3500       0.9974       17.0709
22.00    1.0000       0.0052       113.8595   1982
  1     1     1    2       1      1     1     17      25.3129       454.569     1.3500       0.9974       17.9580
21.90    0.3421       0.0129       113.8595   1983
  1     1     1    2       1      1     2     17      21.0788       378.532     1.3500       0.9974       17.9580
21.90    0.4978       0.0129       113.8595   1983
  1     1     1    2       1      1     3     17      22.4071       402.386     1.3500       0.9974       17.9580
21.90    0.1305       0.0129       113.8595   1983
  1     1     1    2       1      1     4     17      28.3555       509.207     1.3500       0.9974       17.9580
21.90    0.0297       0.0129       113.8595   1983
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  1     1     1    2       1      2     5     17       3.4052        61.151      1.3500       0.9974       17.9580
21.90     1.0000       0.0129       113.8595   1983
  1     1     1    2       1      1     1     16      24.4438       461.732      1.3500       0.9974       18.8896
22.20     0.3421       0.0239       113.8595   1984
  1     1     1    2       1      1     2     16      20.3615       384.620      1.3500       0.9974       18.8896
22.20     0.4978       0.0239       113.8595   1984
  1     1     1    2       1      1     3     16      21.2794       401.959      1.3500       0.9974       18.8896
22.20     0.1305       0.0239       113.8595   1984
  1     1     1    2       1      1     4     16      27.4868       519.214      1.3500       0.9974       18.8896
22.20     0.0297       0.0239       113.8595   1984
  1     1     1    2       1      2     5     16       3.0996        58.549      1.3500       0.9974       18.8896
22.20     1.0000       0.0239       113.8595   1984
  1     1     1    2       1      1     1     15      22.8279       453.570      1.3500       0.9974       19.8691
22.90     0.3421       0.0252       113.8595   1985
  1     1     1    2       1      1     2     15      19.0047       377.606      1.3500       0.9974       19.8691
22.90     0.4978       0.0252       113.8595   1985
  1     1     1    2       1      1     3     15      19.4879       387.207      1.3500       0.9974       19.8691
22.90     0.1305       0.0252       113.8595   1985
  1     1     1    2       1      1     4     15      25.7501       511.631      1.3500       0.9974       19.8691
22.90     0.0297       0.0252       113.8595   1985
  1     1     1    2       1      2     5     15       2.6410        52.475      1.3500       0.9974       19.8691
22.90     1.0000       0.0252       113.8595   1985
  1     1     1    2       1      1     1     14      19.2651       402.642      1.3500       0.9974       20.9000
23.70     0.3421       0.0242       113.8595   1986
  1     1     1    2       1      1     2     14      16.0973       336.435      1.3500       0.9974       20.9000
23.70     0.4978       0.0242       113.8595   1986
  1     1     1    2       1      1     3     14      15.9591       333.546      1.3500       0.9974       20.9000
23.70     0.1305       0.0242       113.8595   1986
  1     1     1    2       1      1     4     14      22.1762       463.484      1.3500       0.9974       20.9000
23.70     0.0297       0.0242       113.8595   1986
  1     1     1    2       1      2     5     14       2.1322        44.562      1.3500       0.9974       20.9000
23.70     1.0000       0.0242       113.8595   1986
  1     1     1    2       1      1     1     13      18.2656       401.571      1.3500       0.9974       21.9851
23.80     0.3421       0.0209       113.8595   1987
  1     1     1    2       1      1     2     13      15.4413       339.479      1.3500       0.9974       21.9851
23.80     0.4978       0.0209       113.8595   1987
  1     1     1    2       1      1     3     13      15.2259       334.742      1.3500       0.9974       21.9851
23.80     0.1305       0.0209       113.8595   1987
  1     1     1    2       1      1     4     13      21.4902       472.464      1.3500       0.9974       21.9851
23.80     0.0297       0.0209       113.8595   1987
  1     1     1    2       1      2     5     13       1.9601        43.093      1.3500       0.9974       21.9851
23.80     1.0000       0.0209       113.8595   1987
  1     1     1    2       1      1     1     12      13.3889       309.645      1.3500       0.9974       23.1270
24.30     0.3421       0.0199       113.8595   1988
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  1     1     1    2       1      1     2     12      11.1990       259.000     1.3500       0.9974       23.1270
24.30     0.4978       0.0199       113.8595   1988
  1     1     1    2       1      1     3     12      10.0108       231.520     1.3500       0.9974       23.1270
24.30     0.1305       0.0199       113.8595   1988
  1     1     1    2       1      1     4     12      16.9253       391.432     1.3500       0.9974       23.1270
24.30     0.0297       0.0199       113.8595   1988
  1     1     1    2       1      2     5     12       1.5567        36.002     1.3500       0.9974       23.1270
24.30     1.0000       0.0199       113.8595   1988
  1     1     1    2       1      1     1     11      13.1849       320.741     1.3500       0.9974       24.3264
23.90     0.3421       0.0243       113.8595   1989
  1     1     1    2       1      1     2     11      11.0090       267.810     1.3500       0.9974       24.3264
23.90     0.4978       0.0243       113.8595   1989
  1     1     1    2       1      1     3     11       9.8738       240.194     1.3500       0.9974       24.3264
23.90     0.1305       0.0243       113.8595   1989
  1     1     1    2       1      1     4     11      16.7257       406.875     1.3500       0.9974       24.3264
23.90     0.0297       0.0243       113.8595   1989
  1     1     1    2       1      2     5     11       1.4465        35.187     1.3500       0.9974       24.3264
23.90     1.0000       0.0243       113.8595   1989
  1     1     1    2       1      1     1     10      12.4081       317.517     1.3500       0.9974       25.5895
23.60     0.3421       0.0331       113.8595   1990
  1     1     1    2       1      1     2     10      10.3426       264.662     1.3500       0.9974       25.5895
23.60     0.4978       0.0331       113.8595   1990
  1     1     1    2       1      1     3     10       9.0344       231.185     1.3500       0.9974       25.5895
23.60     0.1305       0.0331       113.8595   1990
  1     1     1    2       1      1     4     10      15.9303       407.650     1.3500       0.9974       25.5895
23.60     0.0297       0.0331       113.8595   1990
  1     1     1    2       1      2     5     10       1.1894        30.437     1.3500       0.9974       25.5895
23.60     1.0000       0.0331       113.8595   1990
  1     1     1    2       1      1     1      9      11.5907       312.002     1.3500       0.9974       26.9184
23.80     0.3421       0.0342       113.8595   1991
  1     1     1    2       1      1     2      9       9.6241       259.066     1.3500       0.9974       26.9184
23.80     0.4978       0.0342       113.8595   1991
  1     1     1    2       1      1     3      9       8.2808       222.907     1.3500       0.9974       26.9184
23.80     0.1305       0.0342       113.8595   1991
  1     1     1    2       1      1     4      9      15.2099       409.427     1.3500       0.9974       26.9184
23.80     0.0297       0.0342       113.8595   1991
  1     1     1    2       1      2     5      9       1.1157        30.034     1.3500       0.9974       26.9184
23.80     1.0000       0.0342       113.8595   1991
  1     1     1    2       1      1     1      8      10.9940       311.297     1.3500       0.9974       28.3152
23.50     0.3421       0.0398       113.8595   1992
  1     1     1    2       1      1     2      8       9.0893       257.366     1.3500       0.9974       28.3152
23.50     0.4978       0.0398       113.8595   1992
  1     1     1    2       1      1     3      8       7.7334       218.974     1.3500       0.9974       28.3152
23.50     0.1305       0.0398       113.8595   1992
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  1     1     1    2       1      1     4      8       14.6343       414.371      1.3500       0.9974       28.3152
23.50     0.0297       0.0398       113.8595    1992
  1     1     1    2       1      2     5      8        1.0088        28.565      1.3500       0.9974       28.3152
23.50     1.0000       0.0398       113.8595    1992
  1     1     1    2       1      1     1      7       10.0948       300.669      1.3500       0.9974       29.7845
24.00     0.3421       0.0486       113.8595    1993
  1     1     1    2       1      1     2      7        8.3049       247.356      1.3500       0.9974       29.7845
24.00     0.4978       0.0486       113.8595    1993
  1     1     1    2       1      1     3      7        6.9519       207.060      1.3500       0.9974       29.7845
24.00     0.1305       0.0486       113.8595    1993
  1     1     1    2       1      1     4      7       13.8906       413.724      1.3500       0.9974       29.7845
24.00     0.0297       0.0486       113.8595    1993
  1     1     1    2       1      2     5      7        0.9584        28.547      1.3500       0.9974       29.7845
24.00     1.0000       0.0486       113.8595    1993
  1     1     1    2       1      1     1      6        9.0282       282.853      1.3500       0.9974       31.3298
23.90     0.3421       0.0663       113.8595    1994
  1     1     1    2       1      1     2      6        7.3400       229.960      1.3500       0.9974       31.3298
23.90     0.4978       0.0663       113.8595    1994
  1     1     1    2       1      1     3      6        5.8462       183.162      1.3500       0.9974       31.3298
23.90     0.1305       0.0663       113.8595    1994
  1     1     1    2       1      1     4      6       13.1193       411.027      1.3500       0.9974       31.3298
23.90     0.0297       0.0663       113.8595    1994
  1     1     1    2       1      2     5      6        0.7929        24.841      1.3500       0.9974       31.3298
23.90     1.0000       0.0663       113.8595    1994
  1     1     1    2       1      1     1      5        7.6340       251.586      1.3500       0.9974       32.9560
24.10     0.3421       0.0817       113.8595    1995
  1     1     1    2       1      1     2      5        6.1206       201.710      1.3500       0.9974       32.9560
24.10     0.4978       0.0817       113.8595    1995
  1     1     1    2       1      1     3      5        4.5768       150.832      1.3500       0.9974       32.9560
24.10     0.1305       0.0817       113.8595    1995
  1     1     1    2       1      1     4      5       12.2167       402.613      1.3500       0.9974       32.9560
24.10     0.0297       0.0817       113.8595    1995
  1     1     1    2       1      2     5      5        0.6408        21.118      1.3500       0.9974       32.9560
24.10     1.0000       0.0817       113.8595    1995
  1     1     1    2       1      1     1      4        6.2454       216.505      1.3500       0.9974       34.6665
24.10     0.3421       0.0950       113.8595    1996
  1     1     1    2       1      1     2      4        4.9360       171.114      1.3500       0.9974       34.6665
24.10     0.4978       0.0950       113.8595    1996
  1     1     1    2       1      1     3      4        3.4524       119.684      1.3500       0.9974       34.6665
24.10     0.1305       0.0950       113.8595    1996
  1     1     1    2       1      1     4      4       11.3117       392.136      1.3500       0.9974       34.6665
24.10     0.0297       0.0950       113.8595    1996
  1     1     1    2       1      2     5      4        0.5551        19.243      1.3500       0.9974       34.6665
24.10     1.0000       0.0950       113.8595    1996
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  1     1     1    2       1      1     1      3       4.8635       177.352      1.3500       0.9974       36.4660
24.20     0.3421       0.1148        113.8595   1997
  1     1     1    2       1      1     2      3       3.7867       138.085      1.3500       0.9974       36.4660
24.20     0.4978       0.1148        113.8595   1997
  1     1     1    2       1      1     3      3       2.4589        89.668      1.3500       0.9974       36.4660
24.20     0.1305       0.1148        113.8595   1997
  1     1     1    2       1      1     4      3      10.3550       377.604      1.3500       0.9974       36.4660
24.20     0.0297       0.1148        113.8595   1997
  1     1     1    2       1      2     5      3       0.5224        19.049      1.3500       0.9974       36.4660
24.20     1.0000       0.1148        113.8595   1997
  1     1     1    2       1      1     1      2       3.3409       128.151      1.3500       0.9974       38.3579
24.30     0.3421       0.1148        113.8595   1998
  1     1     1    2       1      1     2      2       2.5368        97.308      1.3500       0.9974       38.3579
24.30     0.4978       0.1148        113.8595   1998
  1     1     1    2       1      1     3      2       1.4108        54.117      1.3500       0.9974       38.3579
24.30     0.1305       0.1148        113.8595   1998
  1     1     1    2       1      1     4      2       9.3506       358.669      1.3500       0.9974       38.3579
24.30     0.0297       0.1148        113.8595   1998
  1     1     1    2       1      2     5      2       0.4913        18.847      1.3500       0.9974       38.3579
24.30     1.0000       0.1148        113.8595   1998
  1     1     1    2       1      1     1      1       2.1390        86.309      1.3500       0.9974       40.3492
24.00     0.3421       0.1325        113.8595   1999
  1     1     1    2       1      1     2      1       1.6074        64.857      1.3500       0.9974       40.3492
24.00     0.4978       0.1325        113.8595   1999
  1     1     1    2       1      1     3      1       0.8266        33.354      1.3500       0.9974       40.3492
24.00     0.1305       0.1325        113.8595   1999
  1     1     1    2       1      1     4      1       8.7613       353.512      1.3500       0.9974       40.3492
24.00     0.0297       0.1325        113.8595   1999
  1     1     1    2       1      2     5      1       0.4647        18.750      1.3500       0.9974       40.3492
24.00     1.0000       0.1325        113.8595   1999
  1     1     1    2       1      1     1      0       1.4011        57.238      1.3500       0.9974       40.8534
24.10     0.3421       0.0512        113.8595   2000
  1     1     1    2       1      1     2      0       1.0513        42.948      1.3500       0.9974       40.8534
24.10     0.4978       0.0512        113.8595   2000
  1     1     1    2       1      1     3      0       0.5228        21.359      1.3500       0.9974       40.8534
24.10     0.1305       0.0512        113.8595   2000
  1     1     1    2       1      1     4      0       8.4488       345.162      1.3500       0.9974       40.8534
24.10     0.0297       0.0512        113.8595   2000
  1     1     1    2       1      2     5      0       0.4579        18.705      1.3500       0.9974       40.8534
24.10     1.0000       0.0512        113.8595   2000
  1     1     1    2       2      1     1     24      39.6172       293.115      8.0600       5.7531        7.3987
13.00     0.3421       0.0369         12.5762   1976
  1     1     1    2       2      1     2     24      35.8402       265.170      8.0600       5.7531        7.3987
13.00     0.4978       0.0369         12.5762   1976
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  1     1     1    2       2      1     3      24      41.9071       310.057      8.0600       5.7531       7.3987
13.00     0.1305       0.0369         12.5762   1976
  1     1     1    2       2      1     4      24      45.1550       334.087      8.0600       5.7531       7.3987
13.00     0.0297       0.0369         12.5762   1976
  1     1     1    2       2      2     5      24     166.9363      1235.109      8.0600       5.7531       7.3987
13.00     1.0000       0.0369         12.5762   1976
  1     1     1    2       2      1     1      23      48.0188       399.221      8.0600       5.7531       8.3138
14.20     0.3421       0.0072         12.5762   1977
  1     1     1    2       2      1     2      23      45.7922       380.709      8.0600       5.7531       8.3138
14.20     0.4978       0.0072         12.5762   1977
  1     1     1    2       2      1     3      23      55.1301       458.343      8.0600       5.7531       8.3138
14.20     0.1305       0.0072         12.5762   1977
  1     1     1    2       2      1     4      23      57.0215       474.067      8.0600       5.7531       8.3138
14.20     0.0297       0.0072         12.5762   1977
  1     1     1    2       2      2     5      23     172.5614      1434.648      8.0600       5.7531       8.3138
14.20     1.0000       0.0072         12.5762   1977
  1     1     1    2       2      1     1      22      47.7924       445.594      8.0600       5.7531       9.3235
13.90     0.3421       0.0073         12.5762   1978
  1     1     1    2       2      1     2      22      45.4921       424.147      8.0600       5.7531       9.3235
13.90     0.4978       0.0073         12.5762   1978
  1     1     1    2       2      1     3      22      54.7863       510.802      8.0600       5.7531       9.3235
13.90     0.1305       0.0073         12.5762   1978
  1     1     1    2       2      1     4      22      56.6582       528.255      8.0600       5.7531       9.3235
13.90     0.0297       0.0073         12.5762   1978
  1     1     1    2       2      2     5      22     152.5591      1422.390      8.0600       5.7531       9.3235
13.90     1.0000       0.0073         12.5762   1978
  1     1     1    2       2      1     1      21      41.5104       432.889      8.0600       5.7531      10.4284
13.40     0.3421       0.0076         12.5762   1979
  1     1     1    2       2      1     2      21      36.7239       382.973      8.0600       5.7531      10.4284
13.40     0.4978       0.0076         12.5762   1979
  1     1     1    2       2      1     3      21      42.6066       444.320      8.0600       5.7531      10.4284
13.40     0.1305       0.0076         12.5762   1979
  1     1     1    2       2      1     4      21      45.7159       476.746      8.0600       5.7531      10.4284
13.40     0.0297       0.0076         12.5762   1979
  1     1     1    2       2      2     5      21     136.7278      1425.858      8.0600       5.7531      10.4284
13.40     1.0000       0.0076         12.5762   1979
  1     1     1    2       2      1     1      20      41.1628       478.777      8.0600       5.7531      11.6313
16.80     0.3421       0.0078         12.5762   1980
  1     1     1    2       2      1     2      20      36.3830       423.181      8.0600       5.7531      11.6313
16.80     0.4978       0.0078         12.5762   1980
  1     1     1    2       2      1     3      20      42.1693       490.484      8.0600       5.7531      11.6313
16.80     0.1305       0.0078         12.5762   1980
  1     1     1    2       2      1     4      20      45.3328       527.279      8.0600       5.7531      11.6313
16.80     0.0297       0.0078         12.5762   1980
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  1     1     1    2       2      2     5      20      121.0514       1407.986      8.0600       5.7531       11.6313
16.80     1.0000       0.0078         12.5762    1980
  1     1     1    2       2      1     1      19       35.0140        452.685      8.0600       5.7531       12.9287
18.00     0.3421       0.0079         12.5762    1981
  1     1     1    2       2      1     2      19       32.0948        414.944      8.0600       5.7531       12.9287
18.00     0.4978       0.0079         12.5762    1981
  1     1     1    2       2      1     3      19       37.6002        486.121      8.0600       5.7531       12.9287
18.00     0.1305       0.0079         12.5762    1981
  1     1     1    2       2      1     4      19       40.8678        528.367      8.0600       5.7531       12.9287
18.00     0.0297       0.0079         12.5762    1981
  1     1     1    2       2      2     5      19       34.2374        442.644      8.0600       5.7531       12.9287
18.00     1.0000       0.0079         12.5762    1981
  1     1     1    2       2      1     1      18       34.6245        495.868      8.0600       5.7531       14.3213
18.30     0.3421       0.0083         12.5762    1982
  1     1     1    2       2      1     2      18       31.7174        454.234      8.0600       5.7531       14.3213
18.30     0.4978       0.0083         12.5762    1982
  1     1     1    2       2      1     3      18       37.1700        532.322      8.0600       5.7531       14.3213
18.30     0.1305       0.0083         12.5762    1982
  1     1     1    2       2      1     4      18       40.4862        579.815      8.0600       5.7531       14.3213
18.30     0.0297       0.0083         12.5762    1982
  1     1     1    2       2      2     5      18       30.9746        443.596      8.0600       5.7531       14.3213
18.30     1.0000       0.0083         12.5762    1982
  1     1     1    2       2      1     1      17       34.7696        549.771      8.0600       5.7531       15.8119
18.90     0.3421       0.0109         12.5762    1983
  1     1     1    2       2      1     2      17       31.8459        503.543      8.0600       5.7531       15.8119
18.90     0.4978       0.0109         12.5762    1983
  1     1     1    2       2      1     3      17       37.3233        590.151      8.0600       5.7531       15.8119
18.90     0.1305       0.0109         12.5762    1983
  1     1     1    2       2      1     4      17       40.7853        644.891      8.0600       5.7531       15.8119
18.90     0.0297       0.0109         12.5762    1983
  1     1     1    2       2      2     5      17       28.6147        452.452      8.0600       5.7531       15.8119
18.90     1.0000       0.0109         12.5762    1983
  1     1     1    2       2      1     1      16       24.3796        424.131      8.0600       5.7531       17.3969
18.60     0.3421       0.0152         12.5762    1984
  1     1     1    2       2      1     2      16       20.3411        353.873      8.0600       5.7531       17.3969
18.60     0.4978       0.0152         12.5762    1984
  1     1     1    2       2      1     3      16       22.6458        393.967      8.0600       5.7531       17.3969
18.60     0.1305       0.0152         12.5762    1984
  1     1     1    2       2      1     4      16       27.8520        484.540      8.0600       5.7531       17.3969
18.60     0.0297       0.0152         12.5762    1984
  1     1     1    2       2      2     5      16       30.6192        532.680      8.0600       5.7531       17.3969
18.60     1.0000       0.0152         12.5762    1984
  1     1     1    2       2      1     1      15       24.1519        460.751      8.0600       5.7531       19.0773
18.70     0.3421       0.0203         12.5762    1985
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  1     1     1    2       2      1     2      15      20.2172       385.689      8.0600       5.7531       19.0773
18.70     0.4978       0.0203         12.5762   1985
  1     1     1    2       2      1     3      15      22.4220       427.750      8.0600       5.7531       19.0773
18.70     0.1305       0.0203         12.5762   1985
  1     1     1    2       2      1     4      15      27.7617       529.617      8.0600       5.7531       19.0773
18.70     0.0297       0.0203         12.5762   1985
  1     1     1    2       2      2     5      15      26.8943       513.069      8.0600       5.7531       19.0773
18.70     1.0000       0.0203         12.5762   1985
  1     1     1    2       2      1     1      14      23.5223       490.521      8.0600       5.7531       20.8535
19.60     0.3421       0.0259         12.5762   1986
  1     1     1    2       2      1     2      14      19.7850       412.586      8.0600       5.7531       20.8535
19.60     0.4978       0.0259         12.5762   1986
  1     1     1    2       2      1     3      14      21.6112       450.667      8.0600       5.7531       20.8535
19.60     0.1305       0.0259         12.5762   1986
  1     1     1    2       2      1     4      14      26.8380       559.666      8.0600       5.7531       20.8535
19.60     0.0297       0.0259         12.5762   1986
  1     1     1    2       2      2     5      14      19.9265       415.536      8.0600       5.7531       20.8535
19.60     1.0000       0.0259         12.5762   1986
  1     1     1    2       2      1     1      13      25.0889       570.160      8.0600       5.7531       22.7256
19.70     0.3421       0.0322         12.5762   1987
  1     1     1    2       2      1     2      13      21.4142       486.649      8.0600       5.7531       22.7256
19.70     0.4978       0.0322         12.5762   1987
  1     1     1    2       2      1     3      13      23.1053       525.081      8.0600       5.7531       22.7256
19.70     0.1305       0.0322         12.5762   1987
  1     1     1    2       2      1     4      13      28.8434       655.483      8.0600       5.7531       22.7256
19.70     0.0297       0.0322         12.5762   1987
  1     1     1    2       2      2     5      13      16.5150       375.313      8.0600       5.7531       22.7256
19.70     1.0000       0.0322         12.5762   1987
  1     1     1    2       2      1     1      12      18.6202       459.798      8.0600       5.7531       24.6936
19.30     0.3421       0.0388         12.5762   1988
  1     1     1    2       2      1     2      12      15.5866       384.888      8.0600       5.7531       24.6936
19.30     0.4978       0.0388         12.5762   1988
  1     1     1    2       2      1     3      12      14.9260       368.576      8.0600       5.7531       24.6936
19.30     0.1305       0.0388         12.5762   1988
  1     1     1    2       2      1     4      12      21.4096       528.681      8.0600       5.7531       24.6936
19.30     0.0297       0.0388         12.5762   1988
  1     1     1    2       2      2     5      12      14.3440       354.204      8.0600       5.7531       24.6936
19.30     1.0000       0.0388         12.5762   1988
  1     1     1    2       2      1     1      11      17.2606       461.814      8.0600       5.7531       26.7554
19.10     0.3421       0.0455         12.5762   1989
  1     1     1    2       2      1     2      11      14.4169       385.730      8.0600       5.7531       26.7554
19.10     0.4978       0.0455         12.5762   1989
  1     1     1    2       2      1     3      11      13.4456       359.742      8.0600       5.7531       26.7554
19.10     0.1305       0.0455         12.5762   1989
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  1     1     1    2       2      1     4     11      19.9300       533.235      8.0600       5.7531       26.7554
19.10     0.0297       0.0455         12.5762   1989
  1     1     1    2       2      2     5     11      12.0720       322.991      8.0600       5.7531       26.7554
19.10     1.0000       0.0455         12.5762   1989
  1     1     1    2       2      1     1     10      16.3819       473.674      8.0600       5.7531       28.9145
18.90     0.3421       0.0520         12.5762   1990
  1     1     1    2       2      1     2     10      13.6517       394.733      8.0600       5.7531       28.9145
18.90     0.4978       0.0520         12.5762   1990
  1     1     1    2       2      1     3     10      12.4449       359.838      8.0600       5.7531       28.9145
18.90     0.1305       0.0520         12.5762   1990
  1     1     1    2       2      1     4     10      19.0003       549.384      8.0600       5.7531       28.9145
18.90     0.0297       0.0520         12.5762   1990
  1     1     1    2       2      2     5     10      10.7823       311.766      8.0600       5.7531       28.9145
18.90     1.0000       0.0520         12.5762   1990
  1     1     1    2       2      1     1      9      15.7262       490.189      8.0600       5.7531       31.1702
19.40     0.3421       0.0581         12.5762   1991
  1     1     1    2       2      1     2      9      13.0804       407.720      8.0600       5.7531       31.1702
19.40     0.4978       0.0581         12.5762   1991
  1     1     1    2       2      1     3      9      11.6927       364.464      8.0600       5.7531       31.1702
19.40     0.1305       0.0581         12.5762   1991
  1     1     1    2       2      1     4      9      18.3503       571.982      8.0600       5.7531       31.1702
19.40     0.0297       0.0581         12.5762   1991
  1     1     1    2       2      2     5      9      10.0683       313.833      8.0600       5.7531       31.1702
19.40     1.0000       0.0581         12.5762   1991
  1     1     1    2       2      1     1      8      14.1028       472.751      8.0600       5.7531       33.5218
19.00     0.3421       0.0637         12.5762   1992
  1     1     1    2       2      1     2      8      11.6972       392.113      8.0600       5.7531       33.5218
19.00     0.4978       0.0637         12.5762   1992
  1     1     1    2       2      1     3      8      10.2172       342.498      8.0600       5.7531       33.5218
19.00     0.1305       0.0637         12.5762   1992
  1     1     1    2       2      1     4      8      16.8336       564.293      8.0600       5.7531       33.5218
19.00     0.0297       0.0637         12.5762   1992
  1     1     1    2       2      2     5      8       8.4302       282.595      8.0600       5.7531       33.5218
19.00     1.0000       0.0637         12.5762   1992
  1     1     1    2       2      1     1      7      12.9581       466.069      8.0600       5.7531       35.9673
19.10     0.3421       0.0685         12.5762   1993
  1     1     1    2       2      1     2      7      10.7202       385.576      8.0600       5.7531       35.9673
19.10     0.4978       0.0685         12.5762   1993
  1     1     1    2       2      1     3      7       9.1684       329.762      8.0600       5.7531       35.9673
19.10     0.1305       0.0685         12.5762   1993
  1     1     1    2       2      1     4      7      15.8299       569.358      8.0600       5.7531       35.9673
19.10     0.0297       0.0685         12.5762   1993
  1     1     1    2       2      2     5      7       7.6029       273.455      8.0600       5.7531       35.9673
19.10     1.0000       0.0685         12.5762   1993
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  1     1     1    2       2      1     1      6      10.6794       411.265      8.0600       5.7531       38.5100
18.90     0.3421       0.0723         12.5762   1994
  1     1     1    2       2      1     2      6       8.7568       337.223      8.0600       5.7531       38.5100
18.90     0.4978       0.0723         12.5762   1994
  1     1     1    2       2      1     3      6       7.1333       274.703      8.0600       5.7531       38.5100
18.90     0.1305       0.0723         12.5762   1994
  1     1     1    2       2      1     4      6      14.1395       544.511      8.0600       5.7531       38.5100
18.90     0.0297       0.0723         12.5762   1994
  1     1     1    2       2      2     5      6       5.3619       206.487      8.0600       5.7531       38.5100
18.90     1.0000       0.0723         12.5762   1994
  1     1     1    2       2      1     1      5       9.0480       372.300      8.0600       5.7531       41.1473
18.70     0.3421       0.0754         12.5762   1995
  1     1     1    2       2      1     2      5       7.3144       300.969      8.0600       5.7531       41.1473
18.70     0.4978       0.0754         12.5762   1995
  1     1     1    2       2      1     3      5       5.6449       232.274      8.0600       5.7531       41.1473
18.70     0.1305       0.0754         12.5762   1995
  1     1     1    2       2      1     4      5      13.0098       535.317      8.0600       5.7531       41.1473
18.70     0.0297       0.0754         12.5762   1995
  1     1     1    2       2      2     5      5       3.9574       162.837      8.0600       5.7531       41.1473
18.70     1.0000       0.0754         12.5762   1995
  1     1     1    2       2      1     1      4       7.4082       325.086      8.0600       5.7531       43.8818
19.00     0.3421       0.0777         12.5762   1996
  1     1     1    2       2      1     2      4       5.8983       258.829      8.0600       5.7531       43.8818
19.00     0.4978       0.0777         12.5762   1996
  1     1     1    2       2      1     3      4       4.2764       187.658      8.0600       5.7531       43.8818
19.00     0.1305       0.0777         12.5762   1996
  1     1     1    2       2      1     4      4      11.8626       520.554      8.0600       5.7531       43.8818
19.00     0.0297       0.0777         12.5762   1996
  1     1     1    2       2      2     5      4       3.2032       140.561      8.0600       5.7531       43.8818
19.00     1.0000       0.0777         12.5762   1996
  1     1     1    2       2      1     1      3       5.8267       272.170      8.0600       5.7531       46.7108
18.80     0.3421       0.0793         12.5762   1997
  1     1     1    2       2      1     2      3       4.5650       213.235      8.0600       5.7531       46.7108
18.80     0.4978       0.0793         12.5762   1997
  1     1     1    2       2      1     3      3       3.0774       143.746      8.0600       5.7531       46.7108
18.80     0.1305       0.0793         12.5762   1997
  1     1     1    2       2      1     4      3      10.7185       500.670      8.0600       5.7531       46.7108
18.80     0.0297       0.0793         12.5762   1997
  1     1     1    2       2      2     5      3       2.9819       139.287      8.0600       5.7531       46.7108
18.80     1.0000       0.0793         12.5762   1997
  1     1     1    2       2      1     1      2       3.9892       198.006      8.0600       5.7531       49.6351
19.00     0.3421       0.0802         12.5762   1998
  1     1     1    2       2      1     2      2       3.0392       150.851      8.0600       5.7531       49.6351
19.00     0.4978       0.0802         12.5762   1998
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  1     1     1    2       2      1     3      2        1.7421        86.467      8.0600        5.7531        49.6351
19.00     0.1305       0.0802         12.5762   1998
  1     1     1    2       2      1     4      2        9.4455       468.826      8.0600        5.7531        49.6351
19.00     0.0297       0.0802         12.5762   1998
  1     1     1    2       2      2     5      2        2.7776       137.868      8.0600        5.7531        49.6351
19.00     1.0000       0.0802         12.5762   1998
  1     1     1    2       2      1     1      1        2.5210       132.751      8.0600        5.7531        52.6573
18.70     0.3421       0.0808         12.5762   1999
  1     1     1    2       2      1     2      1        1.8893        99.487      8.0600        5.7531        52.6573
18.70     0.4978       0.0808         12.5762   1999
  1     1     1    2       2      1     3      1        0.9714        51.149      8.0600        5.7531        52.6573
18.70     0.1305       0.0808         12.5762   1999
  1     1     1    2       2      1     4      1        8.6963       457.924      8.0600        5.7531        52.6573
18.70     0.0297       0.0808         12.5762   1999
  1     1     1    2       2      2     5      1        2.6044       137.143      8.0600        5.7531        52.6573
18.70     1.0000       0.0808         12.5762   1999
  1     1     1    2       2      1     1      0        1.6019        85.571      8.0600        5.7531        53.4190
18.70     0.3421       0.0202         12.5762   2000
  1     1     1    2       2      1     2      0        1.1964        63.913      8.0600        5.7531        53.4190
18.70     0.4978       0.0202         12.5762   2000
  1     1     1    2       2      1     3      0        0.5741        30.669      8.0600        5.7531        53.4190
18.70     0.1305       0.0202         12.5762   2000
  1     1     1    2       2      1     4      0        8.3065       443.726      8.0600        5.7531        53.4190
18.70     0.0297       0.0202         12.5762   2000
  1     1     1    2       2      2     5      0        2.5608       136.796      8.0600        5.7531        53.4190
18.70     1.0000       0.0202         12.5762   2000
```

Appendix 4

Comments on Draft Report

and

ADEQ Responses to Comments Received

Appendix 4a

Written Comments on Draft Report

From: Lee Comrie <LComrie@pagnet.org>
To: <domsky.ira@azdeq.gov>, <mswg@pagnet.org>
Date: 11/18/04 09:46:57
Subject: draft report VEI HB 2501 and 2294-comments

Dear Mr. Domsky:

The Pima Association of Governments (PAG) has reviewed the Draft Report on Potential Exemptions from Vehicle Emissions Testing for Motorcycles, Collectible Vehicles, Vehicles 25 Model Years Old, and Older prepared to meet the requirements of House Bills 2501 and 2294. The following comments are being submitted for your consideration:

1. In Section 2.2 **B** Modeling (page 13) the modeling input parameters are outlined. It should be noted that for Area B the appropriate altitude should be an average of high and low emission factors. ADEQ has confirmed that an average of high and low altitude was used but was not properly noted in the table.

2. In the same table, the winter oxygenated fuel content used was 3.5%. As outlined in the PAG CO Limited Maintenance Plan (LMP), 1.8% is the correct content and should be used for the analysis. The PAG CO LMP does include a contingency measure of incremental increases to the fuel oxygen content up to 3.5% if needed to prevent a violation. The current level remains at 1.8%.

3. In the same table, the vehicle miles traveled (VMT) for Area B used was 23,762,562 miles per day. That number should be changed to 19,382,125 miles per day for 2003, to reflect the mileage used in the 2003-07 Transportation Improvement Program analysis. This number includes local/off-system collectors.

4. In Section 2.3 **B** Analytical Methods, on page 14, the #17 footnote states ATons per day calculated form annual totals (PAG, personal communication).@ This total on-road emissions value referred to in the footnote was actually generated by ADEQ modeling results and reviewed by PAG staff. This should be reflected as such in the footnote.

5. The Technical Support Documents for Evaluating the Emissions Impacts of Exempting Collectible Vehicles and Motorcycles cite the PAG CO LMP for VMT per day for the entire fleet in Pima County, however those data are not available in that document but were obtained from personal communication with PAG staff.

We appreciate your consideration on these matters. For additional information, or if you have any questions, please contact me or Natalie Shepp at (520) 792-1093.

Sincerely,

Lee Comrie
Air Quality Planning Manager
Pima Association of Governments
177 N. Church Ave., Suite 405
Tucson, AZ 85701
Ph: (520) 792-1093 Fax: (520) 620-6981
http://www.pagnet.org
CC: <Toopal.Mohan@azdeq.gov>, nshepp@pagnet.org

From: "Coomer, Steve" <Steve.Coomer@escocorp.com>
To: <imd@azdeq.gov>, <mt1@azdeq.gov>
Date: 11/30/04 13:47:17
Subject: Review of HB 2501/HB2294, mtg 11/23/04.

Dear Ira,

I am attaching my written review of the Draft proposal and its conclusions. I have additional supporting documentation that I will be discussing with Mohan in the near future and wish only to submit this letter ahead of the 30 NOV deadline for responses.

To: Ira Domsky, Deputy Director, Air Quality Division
Mohan Toopal, ADEQ Engineer
Arizona Department of Environmental Quality (ADEQ)

From: Stephen D. Coomer, Mechanical and Manufacturing Engineer
Member: American Motorcyclist Association
Foothills Chapter (Chandler, AZ) Harley Owners Group

Subject: 23 NOV 04 meeting re: ADEQ Draft Report for HB 2501 (2002) and HB 2294 (2003)

Date: 29 NOV 2004

Dear Mr. Domsky and Mr. Toopal,

Thank you for the opportunity to attend the stakeholder meeting concerning the draft report on HB 2501 and HB 2294. My initial review of the document resulted in my belief that the values stated for motorcycle emissions were in error and indicated emissions levels approximately 7.3 times greater than actual values. Discussions held after the meeting with Mohan caused me to review the Mobile6.2 model in greater detail.

Of significant interest in the review of various Mobile models from 4.0 through the Mobile6.2 model is one simple underlying statement: "The Mobile model does not calculate any emissions benefit for subjecting motorcycles to IM (inspection and maintenance) requirements." In my research of the various versions of the model, this statement was prevalent in all documentation packages for each version. This is one of the primary reasons that most states using emissions testing have never included motorcycles in their test program. Most notably included in this group of states are Tennessee and California (the California Air Resources Board standards are the basis for all EPA test criteria nationwide). Tennessee has taken the position that their emissions

testing program cannot regulate the two largest contributors of particulate in their air: smokestacks and diesel trucks and cars. Of the states that initially included testing of motorcycles (AZ, KY, NY, NJ, among others) Arizona remains the one state that continues to test motorcycles even though the model cannot predict nor calculate any benefits for doing so.

Throughout the study, it is mentioned that motorcycles are treated as Class 3 Light Duty Vehicles (LDV) for modeling purposes. The various tables, charts, and graphs presented routinely use the term "estimated" with no definition provided for what constitutes a Class 3 LDV. As a point of comparison, the typical 4-cylinder sedan (presumably a Class 3 LDV) has an average displacement of 2.2 liters or 2200 cc's. That is almost 2.5 times the average motorcycle displacement of 900cc's. These numbers are based on a survey of compact 4-door sedans available from the manufacturers presently selling cars in the United States. The motorcycle engine displacement is based on an informal survey conducted during a recent motorcycle event in Tempe. A full report of that survey, conducted on 6 NOV 2004 at Tempe Town Lake is available upon request.

Since the engine displacement is not taken into account as an average, the output of the testing as well as the Mobile6.2 estimated IM benefits are invalid concerning motorcycles. This conclusion is based on the statements within the Mobile6.2 documentation regarding motorcycles as well as the statements contained within the ADEQ Draft document. This is further supported by the fact that emissions output is a function of the engine volume multiplied by the average operating speed and temperature of the vehicle. Fuel economy, engine loading (hp/wt ratio), air-fuel mixture ratios, and general engine condition are all factors that cannot be accurately modeled within the Mobile model.

All of these factors must be fully considered in determining the final true emissions output under nominal conditions. Most significantly, the fuel burned during combustion is the primary contributor to the total emissions of a vehicle and is a function of the fuel efficiency (in miles per gallon). The Mobile 6.2 model is limited to calculations set at 24.3 miles per gallon in the Draft Report. In actuality, an average motorcycle will routinely obtain fuel economy in the 47-53 miles per gallon range. Idle testing does not provide an accurate test output for determining true emissions produced by an engine.

Engine loading is another factor that cannot be accurately modeled with Mobile6.2 since the average engine size and vehicle weight are unknown factors. To illustrate the differences in loading, a typical LDV has a hp/wt ratio around 0.051 as compared to a typical motorcycle hp/wt ratio of 0.138. This ratio becomes even more important when fully loading the vehicle since the ratio tends to become smaller as weight is added and a

car can obviously carry much more weight than a motorcycle.

Further complicating the Mobile6.2 Estimated Benefits for motorcycles is the fact that motorcycle testing is performed as an Idle-only test. Motorcycle air-fuel mixtures tend to run slightly rich at idle compared to automobiles. The net result of this is to skew the g/mile results in emissions output, yielding numbers much higher than what the values would typically be under nominal running conditions.

For the model to be effective and representative of motorcycles, the assumptions and estimations need to be discarded in favor of developing more accurate testing techniques or correction of the mathematical model. EPA lab-certified testing has yielded valid emissions data that can be easily substituted into the model to yield more accurate results. Based upon the information within the test input and output data from the Draft appendices, the mathematical model used to 'trick' the Mobile6.2 model needs to be recalculated. As previously explained, true emissions output needs to be studied under more realistic factors related to fuel economy at nominal engine speeds and loading. By further adjusting the mathematical model to reflect an 'average' fuel economy, the emission MTPD values for motorcycles should be multiplied by .5106. This value represents the error correction for the model test input of 24.3 mpg versus an average of 47 mpg for an average motorcycle. This correction represents an average based on the test methods and data available from the Draft Study. In actuality, based upon EPA certified testing for vehicles, the average emissions reported for the 2004/2005 study indicates motorcycles contribute (on average) 12 grams per mile of CO and 1.449 grams per mile of HC. The net result of this correction would place all motorcycles within values resulting in full exemption based on the data presented within the Draft. It should be noted that the Draft initial emissions values for motorcycles are taken from an idle test where the air-fuel mixture is typically overly-rich to aid in idle operation and drive-ability.

Of further consideration in the future exemption of motorcycles is the general maintenance and engine condition of the motorcycle. Supporting the idea that motorcycles are better maintained than the "cohort fleet" are the following excerpts from the Draft. From page 18: "For motorcycles, however, it can be assumed that the vast majority of the benefit for their test and repair is outside of the 25 year old and older vehicles category. Only 8% of the motorcycles are within that cohort, and failure rates for motorcycles are much less a function of vehicle age than the failure rates for other vehicle classes." On page 19: " The vast majority of the expected emissions increases that would occur from exempting classes of vehicles from the Arizona IM requirements are associated with vehicles 25 model years and older." The report then contradicts itself a second time concerning motorcycles by

stating on page 20: "This trend may be aggravated by the fact that failure rates increase with vehicle age."

The Draft relied upon a mathematical model that used input from Idle-only testing to estimate and predict the IM benefits from continued testing of motorcycles. The Mobile6.2 model clearly states it is incapable of calculating IM benefits for motorcycles. Various states have established a precedent for the repeal of motorcycle testing due to the limitations of the Mobile model. Some of these precedents are based on motorcycles being a 'minimal' contributor due to fleet size. By contrast, the California motorcycle fleet most closely resembles the Arizona fleet in percentages and annual miles driven and has never been tested.

As stated earlier, the average emissions reported for the EPA 2004/2005 study indicates motorcycles contribute 12 grams per mile of CO and 1.449 grams per mile of HC. These numbers are based on laboratory testing performed in real world conditions using dynamometers and gas sampling/analysis systems certified by the EPA. By comparison, the ADEQ idle-only test 'estimated' emissions of motorcycles yields 31.6 grams/mile CO and 5.42 grams/mile of HC. These numbers reflect an average ADEQ test error (from assumptions based on idle data) of 62% for CO emissions and 72% for HC emissions. The EPA test data includes all of the metric motorcycle manufacturers as well as Harley-Davidson and the various 'American-other' motorcycle manufacturers. As a comprehensive test fleet, the EPA numbers reflect emissions values that could be representative of the average motorcycle in the ADEQ cohort fleet calculations.

Given all of the above discussion, it is my belief that Arizona is spending more on the operation of the program than it is gaining in tangible benefits to the environment. This can be supported by the diminished 'actual' contributions made by motorcycles to emissions in areas A and B as defined in the ADEQ Draft Study. This reduced level of emissions can be verified by substituting the certified EPA values for the 'estimated' ADEQ values in the equations presented within the study. Accordingly, Arizona should work toward discontinuing the motorcycle emissions testing program in an effort of being responsible to the citizens subsidizing this program.

I have appreciated discussing this issue with both of you and look forward to further review and data sharing in the near future.

Regards,

Stephen D. Coomer, Mfg. Eng.
ESCO IMG Tempe
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Tel: 480.968.1647x361
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Charter Member, Past Charter Safety Officer
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CC: <iszauter@ama-cycle.org>, <bobbij2@earthlink.net>, <sjd3@cox.net>, <rayofaz@cox.net>, <priestmma@cox.net>, smusblulgt@aol.com

AZDEQ Air Quality 30 Nov 2004
1110 W. Washington St.
Phoenix, AZ 85007

Re: HB2501/HB2294 Draft Report

Dear AZDEQ:

These comments are submitted in addition to comments made at the Draft Report review meeting on 11-23-04.

I support exempting 25 year and older vehicles from emissions testing, as the testing process is counterproductive for many vehicles that are driven only to testing and back or not driven at all in some years. The testing requirement causes extreme hardship on those who have multiple vehicles of minimal use. Some 25 year and older vehicles have been tested as many as 30 times over 30 years. There needs to be an end in sight.

I also support exempting motorcycles from testing. No other state tests motorcycles, and the testing does not provide any consideration from the EPA.

I do not support the current definition of Collectible Vehicle as defined in this report it is far too narrow to be a reasonable and fair definition. The insurance requirement excludes many similar use vehicles that have the same or less environmental impact.

My overall impression is that the impact of terminating emissions testing on vehicles 25 years and older is overestimated by the data used in the modeling. My feeling is that the modeled benefit of testing for CO is 3 to 10 times higher than real world experience would show. Here are some possibilities that I have considered:

1) The estimated deterioration factor may be too high as it does not take into account that the vehicle had been tested for 24 years (or more) prior to the exemption. It is not a vehicle with 25 years of deterioration.
2) The estimated benefit of testing may not accurately predict the reduction due to the testing requirement only and may be "claiming" benefits that occur for other reasons. For example, if a vehicle fails testing by 0.5%, the maximum benefit from testing can only be the 0.5% above the standard, even though the follow-on passing test may indicate reduction below the standard. Testing can only claim a benefit to the standard, not any benefit below the standard.
3) The annual mileage estimates for the 25 year and older vehicles may be overestimated substantially. Most 25 year and older vehicles are non-primary vehicles and are driven far less than primary vehicles.
4) Most real world validating studies, such as those that used remote sensing, showed little or no difference from tested vs. untested vehicles. This would indicate that the testing benefits do not represent the fleet averages.

However, if the modeling is to be used as it is and counterbalancing emissions reduction benefits are to be used to provide a 25 year and older exemption, I would like to have

sufficient additional data included in the report to enable comparative analysis. Please include the following in the report:

1) HC and CO benefits of testing the first 5 year age vehicles in each of Area A and Area B.
2) HC and CO benefits of testing vehicles in Green Valley for Area B.
3) Comparative data for HC and CO impact of exempting 25 years and older (from at least 2 other states that have exempted 25 years and older).
4) Comparative data for HC and CO impact of the existing exemption for 1966 and older vehicles.
5) Copy of the vehicle registration database data from MVD that was used in the modeling.

My conclusion is that the impact of exempting 25 year and older vehicles (even with the current modeled data) is less than 1% in both Area A and Area B and should be adopted. This is especially so in Area B, where there is no actual need for testing at all.

If the presumed benefit of testing must be compensated by other means, then including the first 5-year age vehicles into testing should be adopted. Now that all those vehicles are using OBD II for testing, the benefit for air quality should be far more than the redundant continued testing of 25 year and older vehicles.

I will continue to review the data in the Draft Report and the final version and provide my input to the legislative process to recommend a fair and equitable emissions testing policy for the citizens of Arizona.

Thank you for your consideration.

Mark C. Spear
Automobile Hobbyist
7855 E. Pinon Circle
Tucson, AZ 85712

520-795-9050 Day
520-795-9083 Fax
520-419-4364 Cell

cc: State Senator Tim Bee
cc: State Representative Marian McClure
cc: State Representative Russell Pearce

Appendix 4b

Responsiveness Summary

RESPONSIVENESS SUMMARY

Draft Report on Potential Exemptions from Vehicle Emissions Testing for Motorcycles, Collectible Vehicles and Vehicles 25 Model Years Old and Older

The report was made available to stakeholders on November 9, 2005, and was the subject of a public meeting on November 23, 2005. Three comment letters were received by the November 30, 2005, deadline. ADEQ's responses to oral and written comments follow.

Oral Comments Received at the Public Meeting

Comment: Correct the miles per day per vehicle on Page 5 and the Table on Page 16 and compare to Appendix 2B to ensure consistency.

Response: These corrections were made

Comment: Add to the list of equivalent measures the concept of pollution credit banking and trading for use of clean new vehicles, similar to trading programs for industry.

Response: While banking and trading pollution credits from mobile sources may be a good idea, several obstacles exist to providing information on and implementation of such an emissions control program.

First, no ready evaulation is available that would provide an estimate of potential emissions benefits for the greater Phoenix or Tucson areas, and ADEQ has insufficient time to conduct its own evaluation. Without that information, it would not be possible to determine if additional control measures would be needed replace the emissions reductions currently credited for requiring these classes of vehicles to comply with emissions inspections law.

Second, EPA guidance on mobile source emissions credit banking and trading programs includes numerous restrictions on the documentation and use of such credits. Only one or two programs have ever been approved by EPA. In all cases, EPA required states to have those credits expire in 5 years or less. EPA justifications for these restrictions include the potential for and ease of the cleaner vehicles leaving the nonattainment area, difficulties associated with documenting continuous compliance with lower emission limits and that mobile source emissions controls are much less durable than stationary source controls.

Comment: Include the Voluntary Vehicle Repair and Retrofit Program in the list of potential controls.

Response: It is already included in Table 3 of the Report.

Lee Comrie, Pima Association of Governments

Comment: In Section 2.2 – Modeling (page 13) the modeling input parameters are outlined. It should be noted that for Area B the appropriate altitude should be an average of high and low emission factors. ADEQ has confirmed that an average of high and low altitude was used but was not properly noted in the table.

Response: ADEQ will make necessary edits in the report.

Comment: In the same table, the winter oxygenated fuel content used was 3.5%. As outlined in the PAG CO Limited Maintenance Plan (LMP), 1.8% is the correct content and should be used for the analysis. The PAG CO LMP does include a contingency measure of incremental increases to the fuel oxygen content up to 3.5% if needed to prevent a violation. The current level remains at 1.8%.

Response: ADEQ will model with the new oxygenate content (1.8%) for Area B for the winter season.

Comment: In the same table, the vehicle miles traveled (VMT) for Area B used was 23,762,562 miles per day. That number should be changed to 19,382,125 miles per day for 2003, to reflect the mileage used in the 2003-07 Transportation Improvement Program analysis. This number includes local/off-system collectors.

Response: ADEQ will apply the new VMT figure to a revised analysis. It should be noted that the reduction in VMT has not resulted in a significant deviation from the original result.

Comment: In Section 2.3 – Analytical Methods, on page 14, the #17 footnote states "Tons per day calculated form annual totals (PAG, personal communication)." This total on-road emissions value referred to in the footnote was actually generated by ADEQ modeling results and reviewed by PAG staff. This should be reflected as such in the footnote.

Response: This number was derived from ADEQ's modeling after concurring on the inputs and available data with PAG. This will be reflected in the footnote.

Comment: The Technical Support Documents for Evaluating the Emissions Impacts of Exempting Collectible Vehicles and Motorcycles cite the PAG CO LMP for VMT per day for the entire fleet in Pima County, however those data are not available in that document but were obtained from personal communication with PAG staff.

Response: The report will be edited appropriately.

Stephen D. Coomer

Comment: One of the primary reasons that most states using emissions testing have never included motorcycles in their test program is because the MOBILE model does not calculate a benefit for testing motorcycles. Various states have established a precedent for the repeal of motorcycle testing due to the limitations of the Mobile model.

Response: The reason MOBILE6 does not include IM benefits for motorcycles is that EPA developed the model based on the national averages for vehicle fleets and their usage. The average mass emissions for motorcycles is insignificant as compared to the rest of the fleet in most of the other states. This is reflected in EPA requirements for IM programs, as motorcycle testing was not mandated for either basic or enhanced programs. It is speculative, however, to assign motivation for not testing motorcycles to the performance of the model; states tend to make decisions on pollution control measures based more upon a wider variety of factors, including the amount and cost-effectiveness of emissions reductions, ability to adequately implement and enforce the controls, and their public acceptability. Motorcycles were included in the Arizona IM program by the Legislature based on, among other things, the need for the emissions reductions that could be achieved.

Comment: Throughout the study, it is mentioned that motorcycles are treated as Class 3 Light Duty Vehicles (LDV) for modeling purposes. The various tables, charts, and graphs presented routinely use the term "estimated" with no definition provided for what constitutes a Class 3 LDV. As a point of comparison, the typical 4-cylinder sedan (presumably a Class 3 LDV) has an average displacement of 2.2 liters or 2200 cc's. That is almost 2.5 times the average motorcycle displacement of 900cc's. Since the engine displacement is not taken into account as an average, the output of the testing as well as the Mobile6.2 estimated IM benefits are invalid concerning motorcycles.

Response: The Class 3 category is the smallest LDV's tested: those with four or fewer cylinder engines and a gross vehicle weight rating (GVWR) of 6,000 pounds or less. This clarification will be made in the Report. This approach was taken to obtain a result from the model as to the benefits that would be expected for subjecting these vehicles to the same test applied to motorcycles in Arizona: idle only. Modeled results had to be adjusted to account for the emissions differences between Class 3 LDVs and motorcycles.

Comment: Emissions output is a function of the engine volume multiplied by the average operating speed and temperature of the vehicle. Fuel economy, engine loading (hp/wt ratio), air-fuel mixture ratios, and general engine condition are all factors that cannot be accurately modeled within the Mobile model. All of these factors must be fully considered in determining the final true emissions output under nominal conditions. Most significantly, the fuel burned during combustion is the primary contributor to the total emissions of a vehicle and is a function of the fuel efficiency (in miles per gallon). Engine loading is another factor that cannot be accurately

modeled with Mobile6.2 since the average engine size and vehicle weight are unknown factors.

Response: This is only true if one considers emissions as they emerge from engine, *all things being equal.* The addition of post-combustion control technologies, like catalytic converters, changes the emissions profile so that displacement and operating speed may be independent of emissions. That is why a luxury sedan with a giant 8-cylinder engine achieving 12 miles/gallon can meet the same tailpipe standard as a 3-cylinder subcompact engine achieving 37 miles/gallon. The age and state of repair of an engine are extremely important factors and more apropos to this analysis and the purpose of IM programs. Further, the MOBILE models are not designed to analyze specific vehicles, but to provide an estimate of emissions for vehicle fleets. The data bases relied upon by EPA in developing this model take all of these factors into account, as they would occur across the vehicle fleet.

Comment: The Mobile 6.2 model is limited to calculations set at 24.3 miles per gallon in the Draft Report. In actuality, an average motorcycle will routinely obtain fuel economy in the 47-53 miles per gallon range.

Response: This mileage figure primarily an artifact of how the analysis was done, is not a specific reflection of motorcycle emissions, nor is it particularly relevant. See prior responses.

Comment: Idle testing does not provide an accurate test output for determining true emissions produced by an engine.

Response: ADEQ agrees. It does, however, provide an adequate indicator of the state of repair of an engine, which is why the test is administered. The vast majority of vehicles failing an idle test require either repair (including proper tuning of ignition system and air-fuel ratio or adjustment).

Comment: Further complicating the Mobile6.2 Estimated Benefits for motorcycles is the fact that motorcycle testing is performed as an Idle-only test. Motorcycle air-fuel mixtures tend to run slightly rich at idle compared to automobiles. The net result of this is to skew the g/mile results in emissions output, yielding numbers much higher than what the values would typically be under nominal running conditions.

Response: MOBILE6.2 emissions factors for motorcycles were developed based on transient loaded dynamometer testing, which also includes, but does not rely exclusively on, idle emissions. The idle-only test emissions standards are designed to allow for some variation in idle fuel mixture. Motorcycles with idle emissions high enough to fail are grossly out of adjustment or in need of repair.

Comment: For the model to be effective and representative of motorcycles, the assumptions and estimations need to be discarded in favor of developing more accurate testing techniques or correction of the mathematical model. EPA lab-certified testing has yielded valid emissions data that can be easily substituted into the model to yield results that are more accurate. Based upon the information within the test input and output data from the Draft appendices, the mathematical model used to 'trick' the Mobile6.2 model needs to be recalculated.

Response: Those data were relied upon to develop the motorcycle emissions factors in the MOBILE model. Additional data cannot be obtained in the near term nor are they likely to be developed. Absent the type of rigorous laboratory comparison of motorcycles subject to emissions inspections and those not, it is not possible to do any analysis significantly different than what was performed.

Comment: By further adjusting the mathematical model to reflect an 'average' fuel economy, the emission MTPD values for motorcycles should be multiplied by .5106. This value represents the error correction for the model test input of 24.3 mpg versus an average of 47 mpg for an average motorcycle. This correction represents an average based on the test methods and data available from the Draft Study.

Response: Fuel economy is not relevant to the way this analysis was done (see above comment and ADEQ response). Consequently, that adjustment factor will not be used.

Comment: In actuality, based upon EPA certified testing for vehicles, the average emissions reported for the 2004/2005 study indicates motorcycles contribute (on average) 12 grams per mile of CO and 1.449 grams per mile of HC. The net result of this correction would place all motorcycles within values resulting in full exemption based on the data presented within the Draft.

Response: Notwithstanding the source of this information, average emission rate from the analysis for motorcycles is 12.98 g/mile for CO and 1.97 g/mile for HC which compares well with the one specified in the comment.

Comment: Of further consideration in the future, exemption of motorcycles is the general maintenance and engine condition of the motorcycle. Supporting the idea that motorcycles are better maintained than the "cohort fleet" are the following excerpts from the Draft. From page 18: "For motorcycles, however, it can be assumed that the vast majority of the benefit for their test and repair is outside of the 25 year old and older vehicles category. Only 8% of the motorcycles are within that cohort, and failure rates for motorcycles are much less a function of vehicle age than the failure rates for other vehicle classes."

Response: Following the context of the report, the cited paragraph, "…For motorcycles, however … ", is a sequel to the comparison of collectible vehicles with 25 year old vehicles. The "cohort fleet" in the context of the report is clearly a comparison of a

mere 8% of motorcycles that are 25 years old and older with a much larger fleet. This essentially means that the failure rate of motorcycles 25 years old and older cannot be compared with that of other vehicles of the same age, due to the insignificant size of the motorcycle fleet of that age group.

Comment: On page 19: "The vast majority of the expected emissions increases that would occur from exempting classes of vehicles from the Arizona IM requirements are associated with vehicles 25 model years and older." The report then contradicts itself a second time concerning motorcycles by stating on page 20: "This trend may be aggravated by the fact that failure rates increase with vehicle age."

Response: The second sentence is taken completely out of context, as there are additional paragraphs and discussion of a figure between the statement excerpted from page 19 and the one from page 20. Because the statement from page 20 applies to the previous statement, also on page 20, no contradiction exists.

Comment: As stated earlier, the average emissions reported for the EPA 2004/2005 study indicates motorcycles contribute 12 grams per mile of CO and 1.449 grams per mile of HC. These numbers are based on laboratory testing performed in real world conditions using dynamometers and gas sampling/analysis systems certified by the EPA. By comparison, the ADEQ idle-only test 'estimated' emissions of motorcycles yields 31.6 grams/mile CO and 5.42 grams/mile of HC. These numbers reflect an average ADEQ test error (from assumptions based on idle data) of 62% for CO emissions and 72% for HC emissions. The EPA test data includes all of the metric motorcycle manufacturers as well as Harley-Davidson and the various"American-other" motorcycle manufacturers. As a comprehensive test fleet, the EPA numbers reflect emissions values that could be representative of the average motorcycle in the ADEQ cohort fleet calculations.

Response: The figures alluded to are documented within the report as being derived from MOBILE6.2, not the Arizona IM program. We have discovered that the 31.6 grams/mile CO and 5.42 grams/mile of HC numbers came from MOBILE5a. This error in the report will be corrected and MOBILE6.2 numbers inserted.

Mark Spear

Comment: My overall impression is that the impact of terminating emissions testing on vehicles 25 years and older is overestimated by the data used in the modeling. My feeling is that the modeled benefit of testing for CO is 3 to 10 times higher than real world experience would show. The estimated deterioration factor may be too high as it does not take into account that the vehicle had been tested for 24 years (or more) prior to the exemption. It is not a vehicle with 25 years of deterioration.

Response: No data were offered to support this contention. Regardless of the number of years a vehicle has been subject to emissions testing engines, fuel systems and emissions control equipment continue to deteriorate. This is amply demonstrated with the

failure rates for this cohort of vehicles, which are relatively consistent and more than double the fleet average in both Areas A and B.

Comment: The estimated benefit of testing may not accurately predict the reduction due to the testing requirement only and may be "claiming" benefits that occur for other reasons. For example, if a vehicle fails testing by 0.5%, the maximum benefit from testing can only be the 0.5% above the standard, even though the follow-on passing test may indicate reduction below the standard. Testing can only claim a benefit to the standard, not any benefit below the standard.

Response: By the same token, the benefits of identifying and repairing vehicles failing by large margins are considerably greater. The MOBILE model calculates IM benefit as a reduction in the average emission level for a given class of vehicles. These benefit estimates are based upon large data set of individual testing results, which takes into account the variation found in the fleet.

Comment: The annual mileage estimates for the 25-year and older vehicles may be overestimated substantially. Most 25 year and older vehicles are non-primary vehicles and are driven far less than primary vehicles.

Response: No data exist to either substantiate or refute this contention. The relationships between vehicle age and annual mileage included in the MOBILE model are based upon national survey data. In the absence of reliable data, ADEQ must rely on these default mileage relationships for calculating emissions.

Comment: Most real world validating studies, such as those that used remote sensing, showed little or no difference from tested vs. untested vehicles. This would indicate that the testing benefits do not represent the fleet averages.

Response: No similar evaluation has been performed for the Arizona IM program, which is substantially different from those evaluated in the remote sensing studies to which the commenter refers. The Arizona program underwent a rigorous review in 1999, which also relied on real world data, including remote sensing. See "Using Program Test Result Data to Evaluate the Phoenix I/M Program," Tom Wenzel, Lawrence Berkeley National Laboratory (undated, but submitted to the Joint Legislative Oversight Committee on Vehicle Emissions Testing in the spring of 1999). The report provides a rigorous analysis of the substantial emissions reduction benefits for the program.

Comment: If the modeling is to be used as it is and counterbalancing emissions reduction benefits are to be used to provide a 25-year and older exemption, I would like to have sufficient additional data included in the report to enable comparative analysis. Please include the following in the report:

1) HC and CO benefits of testing the first 5-year age vehicles in each of Area A and Area B.

2) HC and CO benefits of testing vehicles in Green Valley for Area B.

3) Comparative data for HC and CO impact of exempting 25 years and older (from at least 2 other states that have exempted 25 years and older).

4) Comparative data for HC and CO impact of the existing exemption for 1966 and older vehicles.

5) Copy of the vehicle registration database data from MVD that was used in the modeling.

Response:

1) Repealing the exemption for vehicles 1 through 5 model years old has been evaluated and included in the list of potential control measures.

2) We will determine if we can acquire sufficient data to generate such an evaluation. If the analysis can be conducted, it will not be completed in before the deadline for submitting this Report.

3) Because benefits of IM programs vary depending on the stringency of the IM program, elevation, climatic factors, driving patterns, fleet distributions and other factors, valid comparisons of other state and local IM programs with those in Arizona may not be possible. This is illustrated in the difference in emissions benefits between Areas A and B for the same classes of vehicles. We will, however, determine if such evaluations exist and how relevant they may be to Arizona. Any such information will not be available in time to incorporate it into the Report.

4) Such data, if they exist, would be irrelevant, as these vehicles are not subject to testing.

5) We will provide the data used in the analysis. It should be noted that MVD data could not be used in this analysis because MVD lumps all vehicles 25 year old and older into one category. VEI data were used.